JUNE, 1952

APPLIED HYDRAULICS

THE MAGAZINE OF FLUID POWER TRANSMISSION

INCLUDING AIR CONTROLS AND AIR CIRCUIT DESIGN; ELECTRICAL CONTROLS

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PIPING POINTERS FOR HYDRAULIC CIRCUITS ..... Page 38

HOW TO CUT HYDRAULIC TUBING ..... Page 43

HOW TO DETERMINE CYCLE TIME ..... Page 45

AVIATION SECTION ..... Page 70

USEFUL LITERATURE ..... Page 56 NEW COMPONENTS ..... Page 65

Listed on page 2 you'll find 12 articles and 7 regular departments which feature application and design ideas for fluid power equipment

AEROQUIP SELF-SEALING COUPLINGS

AND FLEXIBLE HOSE LINES

BUSES AND TRUCKS

Speed Maintenance

WHEREVER FLUID-CARRYING LINES
MUST BE DISCONNECTED AND RECONNECTED

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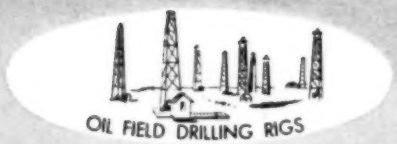
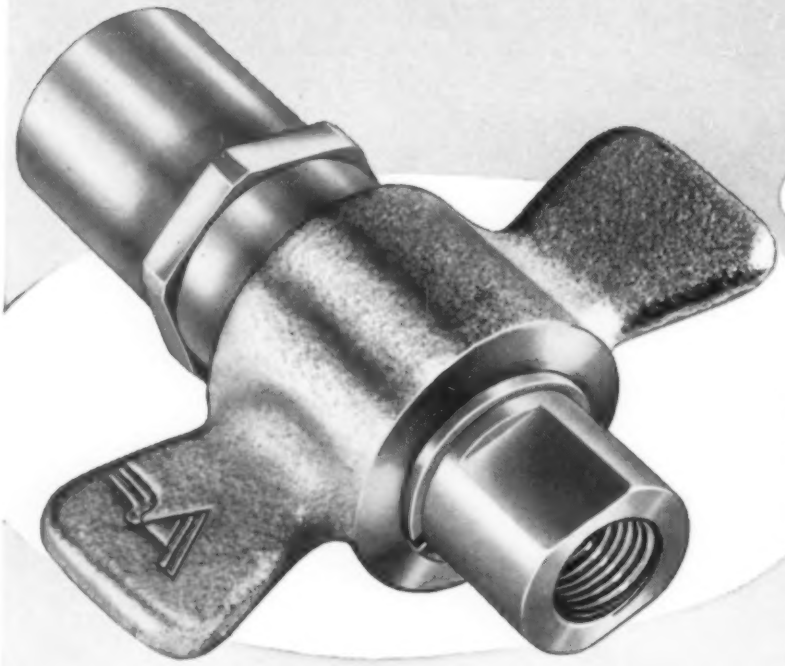


OIL FIELD DRILLING RIGS

MACHINE TOOLS



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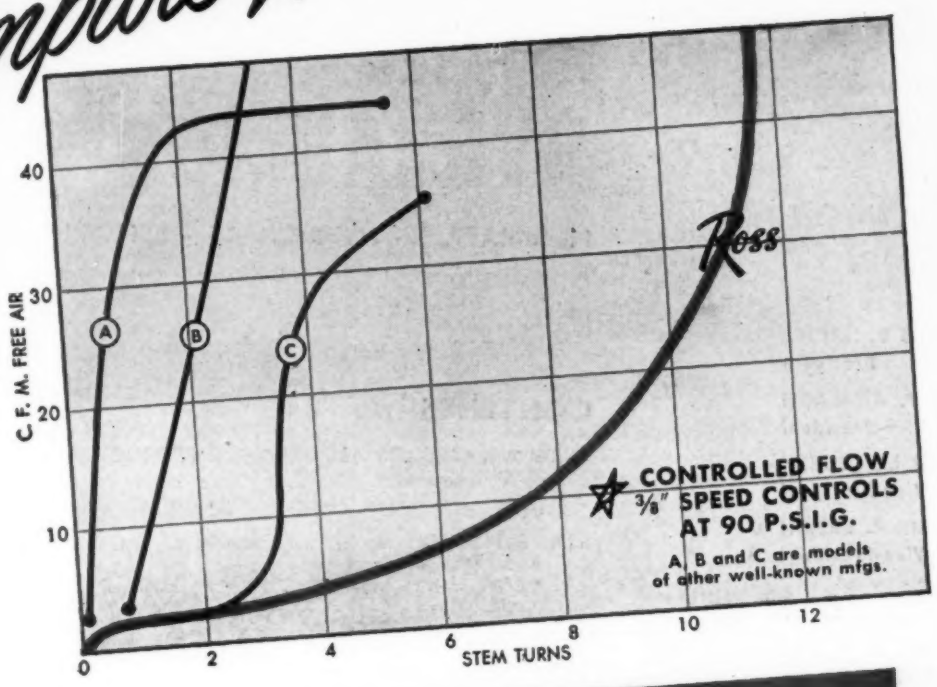

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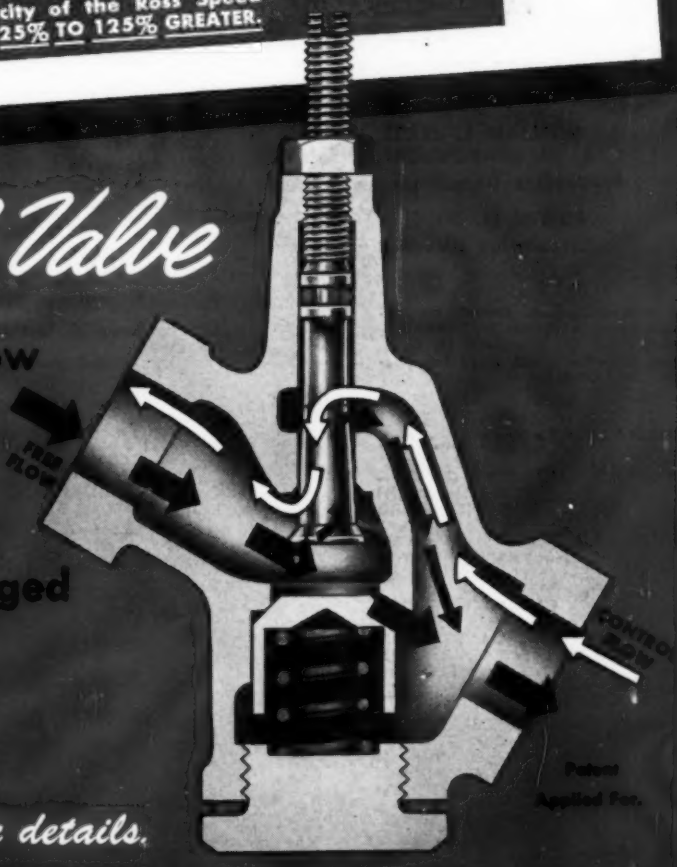

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JUNE, 1952
Vol. 5, No. 6

APPLIED HYDRAULICS

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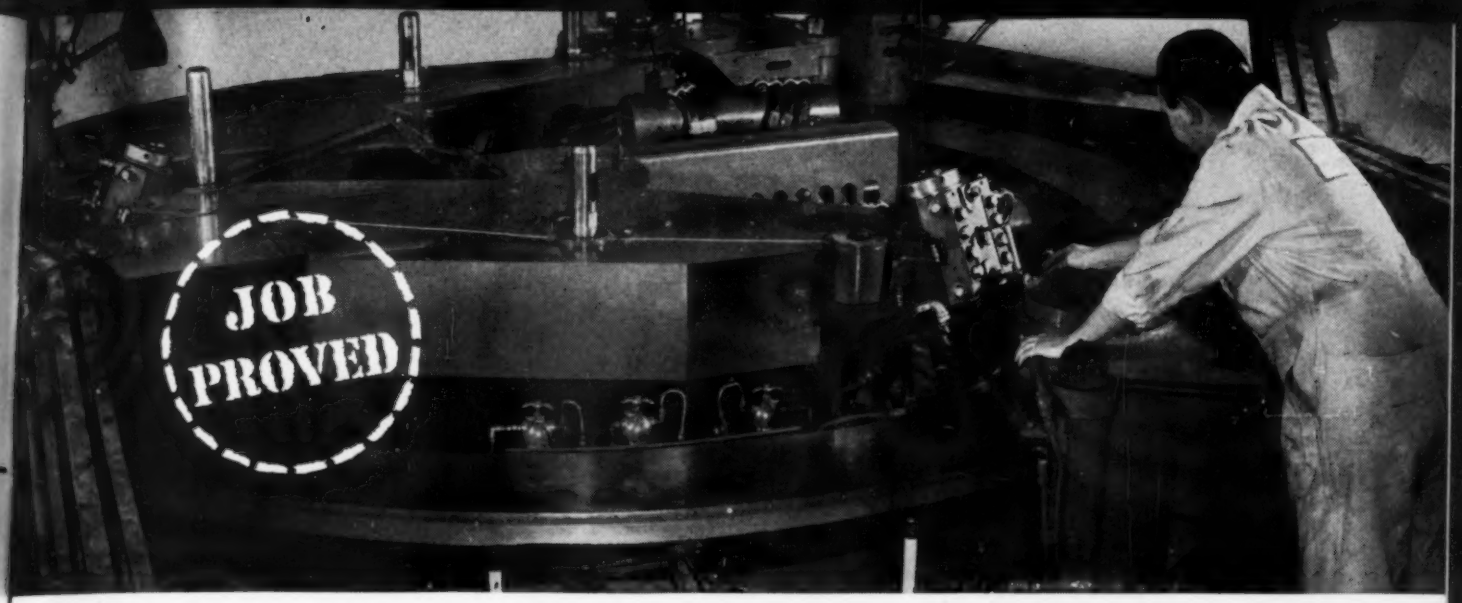
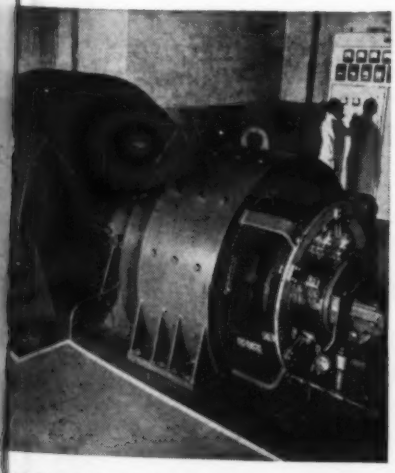


SCIENTIST at Cornell Aeronautical Laboratory gages thin oil film in wind tunnel's oil-cushioned balance system, which measures wind stresses on models to 1/100 of a pound. With the previous oil, rust particles formed, made accurate measurements nearly impossible. Frequent dismantling and cleaning were necessary at a cost of nearly $1,000 each time. Sunvis 931 Oil restored efficiency of the balance system and eliminated overhauls.

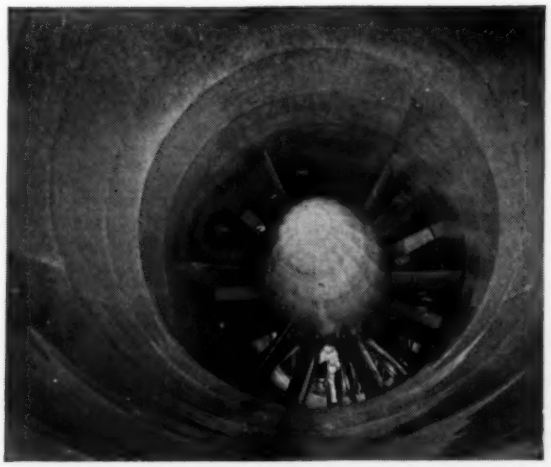
SUNVIS 931 OIL PREVENTS RUST, SPEEDS AIR RESEARCH PROJECT

Cornell Aeronautical Laboratory's transonic wind tunnel, valued at more than $3 million, determines the ability of planes to withstand winds up to 750 mph. Two years ago difficulties set in. In the delicate hydraulic balance system—where parts literally float on a film of oil—particles of rust were interfering with accurate measurements. Every few months the entire balance system had to be dismantled, thoroughly cleaned, then reassembled. But there is no problem today. It was solved when a Sun representative recommended Sunvis 931 Oil with "Job Proved" ability to prevent the formation of rust, corrosion, sludges, and gums.

"Job Proved" Sunvis 900 Series Oils are unsurpassed in quality. Under normal operating conditions *they are good for the life of your machinery*. For complete information, call or write your nearest Sun Office.



WINDS UP TO 750 MPH are generated by these two 12,000 hp electric motors directly connected to the main shaft. Sunvis 931 Oil lubricates and protects them, too.



TWO HIGH-SPEED propellers are also lubricated by Sunvis 931 Oil. It remains free-flowing, nonsludging, after more than two years' rigorous service.

TEST PILOT PREPARES for the take-off, confident in the knowledge that scientific laboratory pretesting has minimized the risks he runs.

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APPLIED HYDRAULICS

Fluid Power Lines

Air Circuits and Tool Designers

This month you'll find two articles describing the use of air circuits to improve production facilities. You might call these circuits "home-brewed" because they are designed by company tool engineers in their continuous efforts to design more efficient fixtures. Phil Lindhuber, chief tool designer at Spicer in Toledo, prepared the article on the design of a shuttling fixture which ties together three standard drilling machines. The result is a transfer type machine. While the air circuit Phil worked out is a real "air engineering" job, it is part of his overall fixture planning which considers the use of air components to power a simple swing-away work loader or to do this complex three station machining job.

Having the right machine tool is just part of the job of turning out work of high quality at a competitive price. Your shop must also have jigs and fixtures which cut production corners and insure quality.

In the second article about air tooling, Cleveland Graphite Bronze Company's maintenance superintendent, Otto Matousek, describes three pneumatic circuits on typical "air tooled" machines. This company uses pneumatics on over 95 percent of its production operations.

Aviation Meetings

The SAE Aviation Hydraulics and Pneumatics Committee A-6, the Pump Committee A-1 and the Flexible Hose Assemblies and Fittings Committee A-3 spring meetings are reported this month in somewhat more detail than previously because of the increasing interest of more manufacturers in aviation components. Approximately one hundred representatives of manufacturers of all types of hydraulic and pneumatic components attended the meetings which ran consecutively for five days. The general specification on the design, installation and tests for aviation hydraulic systems, MIL-H-5440, was approved and final action was taken on many component specifications.

. . . and in the year 2568

Although our short article on "Luigi the Robot Man" is a straight news story about how a smart sales engineer worked up a gimmick to attract crowds at the ASTE show, we were tempted to do it up in the style of science fiction. Luigi has a simple hydraulic system for his "innerds" and sequence valves keep him from getting his feet tangled with his arms. Pressure gauges for eyes present fascinating possibilities —does Luigi pop a Bourdon tube when he meets Gwendolyn?

Calculating Cycle Time

While the mathematics for computing cycle time on hydraulically powered equipment is elementary, the initial planning of operations requires considerable care—this planning of course becomes increasingly important as the number of operations increase. Using a tabular chart and calculation notes, E. R. Johnson, design engineer with The Morris Machine Tool Co., Cincinnati gives you the step-by-step procedure in determining the cycle time on a multi-operation oil powered production machine.

"How to Cut Hydraulic Tubing" is the first part of a comprehensive series by Robert W. Phillips on hydraulic "plumbing". There will be articles about fittings, tubing and hose. The emphasis will be on proper installation to give a piping layout which is easy to maintain, carries pressure oil with a minimum pressure drop between pump and motor, and is free of leaks. You'll also find useful information on available designs of these important circuit parts.

Bob Phillips has spent all of his more than 10 years with The Weatherhead Company in hose and fittings design, application and maintenance work. Bob, at the end of World War II, served as head of his company's laboratory, then as assistant chief engineer on development. His present assignment, as ace trouble-shooter, takes him all over the country, wherever there are tough service problems. Bob is a graduate of Wabash College and has a M.A. in chemistry from the University of Michigan. He is now project engineer, Hose and Fittings Division, The Weatherhead Company.

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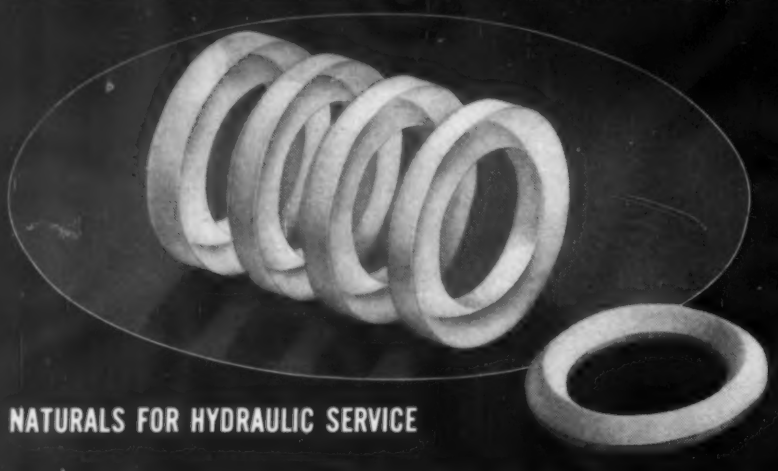

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LETTERS to the Editor

I would like to have a copy of the report or notes of the Aircraft Committee A-3 (discussion of fittings and flexible hose assemblies) meeting which you mentioned in the April issue of APPLIED HYDRAULICS. Would you advise if this information is available.

CHARLES E. DUGAN
Sales Manager
Mulconroy Company

A brief report of SAE A-3 Committee, Aircraft Flexible Hose Assemblies and Fittings will be found in the Aviation Section of this issue. Complete minutes of the meeting are being prepared and may be obtained from William Beckerle, SAE National Headquarters, 29 West 39th Street, New York 18, N. Y.

We would like to obtain the standard JIC hydraulic symbols for use in hydraulic diagrams. Could you tell us where we can obtain this information?

EDWARD C. FILSTRUP
Vice President
Covel Manufacturing Company

Complete copies of the JIC Hydraulic Standards for Industrial Equipment may be obtained from J. C. Rauss, Production Engineering Section, General Motors Corporation, 15-228 General Motors Bldg., Detroit 2, Michigan or from D. P. Morrell, Supervisor Standards and Construction Applications, Ford Motor Company, Rouge Plant, Dearborn, Michigan. Hydraulic component symbols are a part of the Standards. We have just published the series of hydraulic valve symbols which ran serially in APPLIED HYDRAULICS last year. A copy of this booklet has been mailed to you.

We find your articles most interesting and informative and note with regret (December 1951 issue statement) that the articles "Beginners Course in Basic Hydraulics" have not been reprinted. Could you send us as many sets of tear sheets from back numbers as may be still available?

F. R. JACKSON
General Manager
Superflexit, Ltd.
Trading Estate, Slough
Bucks, England

We are sorry that most of the back issue stocks have been depleted. How-

Continued on page 12

Meet William L. Harris

Superintendent

International Packings Corporation

Affiliated with Graton & Knight Company

Graduating with a B.S. Degree in Chemistry from Hamline University in St. Paul, Mr. Harris has devoted his entire career in the two fields of synthetic rubbers and leathers. As a scientist, the government called upon him as a technical adviser to supervise the GRS rubber program. As a production man, he has served as foreman, production manager, and ultimately as development manager for new and experimental work on mechanical packings and specialties. This background has ideally fitted him for his present job as Superintendent. He knows his materials and what each can do. Equally important he knows how to make these materials into efficient packings.

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The type of packings, the material from which they are made, the treatment given that material are important. At G&K-INTERNATIONAL you'll find a wealth of experience on which to base a wise choice.

Equally important is how these packings are made — the step-by-step adherence to tolerances, both dimensional and physical; the proper sequence given to operations and treatments so as to obtain to the fullest those qualities that mean longer life and more efficient service; and, of course, modern machinery, skilled workmen and intelligent supervision all combined to produce those packings most economically. These production advantages are all yours when you specify G&K-INTERNATIONAL packings.

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ROCKFORD, ILLINOIS

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Continued from page 8

ever, the entire set of installments have been photostated and are being assembled into a booklet. When this is available we will announce this fact and send on a set to you. The nominal cost still remains to be determined.

Somehow our copy of the September 1951 issue of APPLIED HYDRAULICS was misplaced. Could you send us a copy or tear sheets of Fred Hosterman's article. "A Progress Report—Nonflammable Hydraulic Fluids"? We are specially interested in the chart used in Mr. Hosterman's article.

W. V. Scholz
Technical Representative
Industrial-Aviation Div.
R. M. Hollingshead Corp.

Fortunately we were still able to find a copy of this issue which has been sent to you. EDITOR'S NOTE: *Copies have been exhausted due to the demand. However, tear sheets or photostats are still available.*

Are reprints of the article "How Much Air?" by Ralph E. Middleton which appeared in the March 1952 issue of APPLIED HYDRAULICS available?

Henry L. Wesl
Detroit, Mich.

In spite of the demand for this article we can still supply sets of tear sheets. A set has been sent to you.

On page 64 of your July 1951 issue you mention a booklet on an nonflammable hydraulic fluid H2. Could you advise me where I might obtain a copy?

Richard H. Moore
Hydraulic Designer
Bristol Aeroplane Co., Ltd.
Bristol, England

Your request has been forwarded to the manufacturer, R. M. Hollingshead Corporation, Camden, N. J.

I have been trying, so far without success, to obtain a small quantity of "O" ring seals for some experimental work I am doing. These rings should measure 13/32 inch OD and have a cross section diameter of 1/16 inch; they should be of Neoprene and maintain ductility at −20 F at zero psi and also at 80 F at 300 psi. If you can give the the names and addresses of some manufacturers of these items it would be greatly appreciated.

Alfred K. Poe,
Manager
West Penn Refrigeration Co.

The nominal OD you require is not a standard size, however, it is possible that you could use the 3/8

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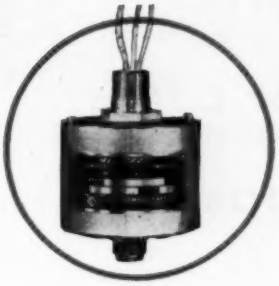

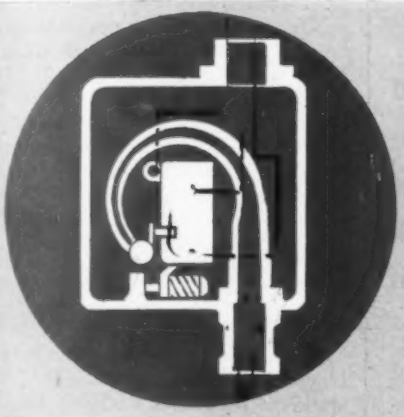

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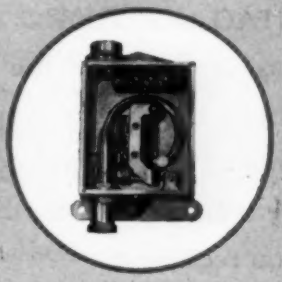
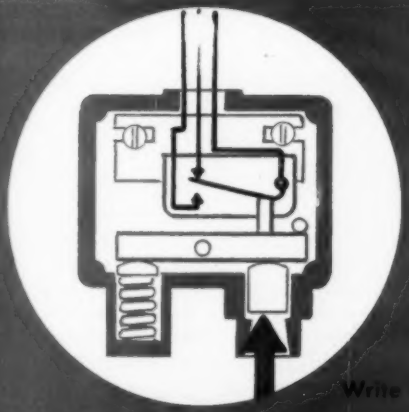
For higher pressures (to 10,000 psi). Available in 6 classes of adjustable ranges from 15 to 10,000 psi with proof pressures ranging from 500 to 15,000 psi. Duronze and SAE 4130 Bourdon tube sensing element. Pressure port ¼-18, electrical connection ½" conduit.





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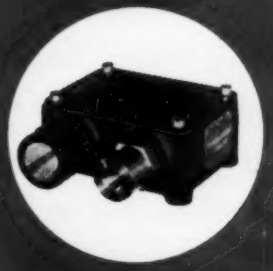
For heavy duty industrial applications. Six classes of piston type pressure sensing elements provide operating ranges from 50 to 10,000 psi. Proof pressure to 15,000 psi. Pressure connection ¼-18, electrical connection ½" conduit.



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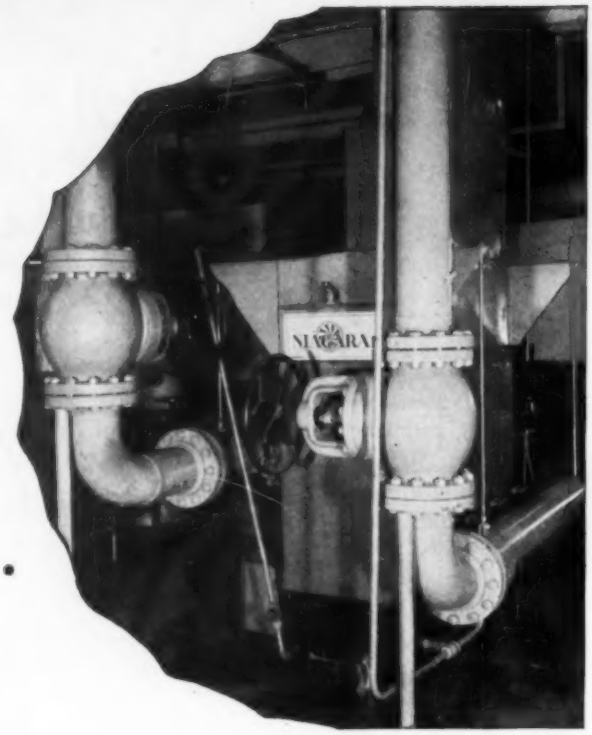
How to get drier or cooler gases . . .



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inch size which is available from a number of manufacturers of "O" rings. This would depend on whether your seal is for static sealing only, the refrigerant in your system and possibly some other factors. Various of the "O" ring manufacturers can, we are sure, make recommendations which will be of value to you. We are sending you tear sheets of directory pages (January 1952 issue of APPLIED HYDRAULICS) listing "O" ring manufacturers.

I would like some information on elementary hydraulic circuits and electrical circuits such as limit switches, relays and solenoids, particularly how such components operate in connection with hydraulic circuits.

WILLIAM ZURGA
Cleveland, Ohio

The literature of leading manufacturers of electrical components, particularly those that specialize in such components as you mention, is the best source of information. Tear sheets of lists of manufacturers of limit switches, relays and solenoids from the Directory issue (1952) of APPLIED HYDRAULICS have been sent you. JIC Electrical and Hydraulic Standards for Industrial Equipment would also be helpful. Electrical standards can be obtained at the same sources as can the Hydraulic Standards (addresses elsewhere in this column).

We would appreciate it very much if you could send us a list of some standard textbooks and handbooks on the subjects of Compresed Air and Oil-Hydraulics. What we particularly need is information to be used in designing machinery with hydraulic and pneumatic controls and cylinders.

S. A. BALKAN
Mech. Eng. Supervisor
Polaroid Corporation

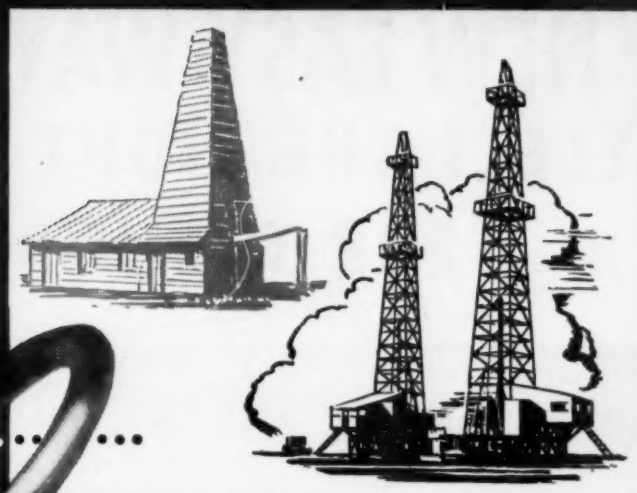
We are sending you a copy of our 1952 APPLIED HYDRAULICS Data List, which, however, is rather light on practical design information. The technical data available in manufacturers' literature is the best source for your designers.

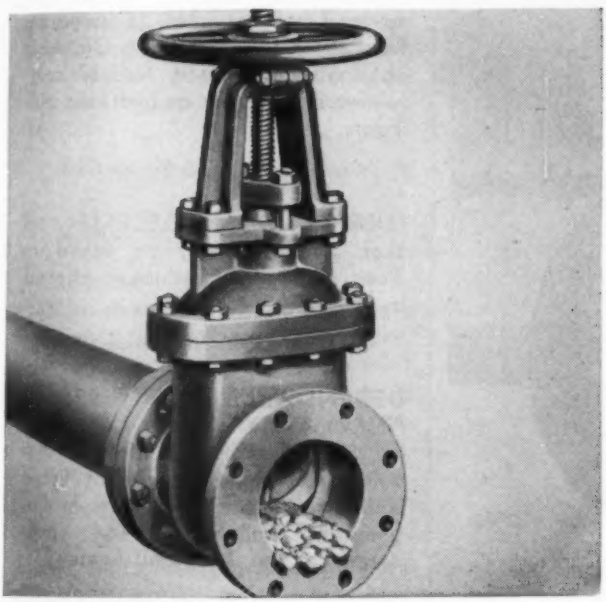
We would like to obtain the address of the Tube Reducing Corporation mentioned in your fine article "Rocket Costs Reduced by Hot and Cold Forming" published in the April issue of APPLIED HYDRAULICS.

L. J. REGGIARDO
California Tackle Co., Inc.

The address of Tube Reducing Corporation is 520 Main St., Wallington, N. J.

Results from designing for greater efficiency...





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MUDCO BUTTERFLY VALVE

More . . . MORE . . . MORE . . . *MORE* oil! *These demands* cannot be met with obsolete equipment. New, better methods and equipment must be designed to increase production, reduce "down-time" and maintenance costs!

LINEAR is playing a more important role in designing for greater oil production. For example, shale and other debris, settling in the seat of the conventional gate valve prevents a perfect seal, thus causing leakage, costly shut-downs and replacement time.

LINEAR "O" Rings, fitted to the disks of Mudco Butterfly Valves, solve the problem. During closure, the "O" ring acts as a wiper, removes the shale, and effects a tight seal. Metal-to-metal wear is entirely eliminated. And, when replacement is finally necessary, the valve is renewed simply by replacing the "O" ring *in the field* without costly machine shop repairs.

To build it better . . . make it simpler . . . to achieve greater efficiency, consult LINEAR in the design stage, to help you with your packing and sealing problems.

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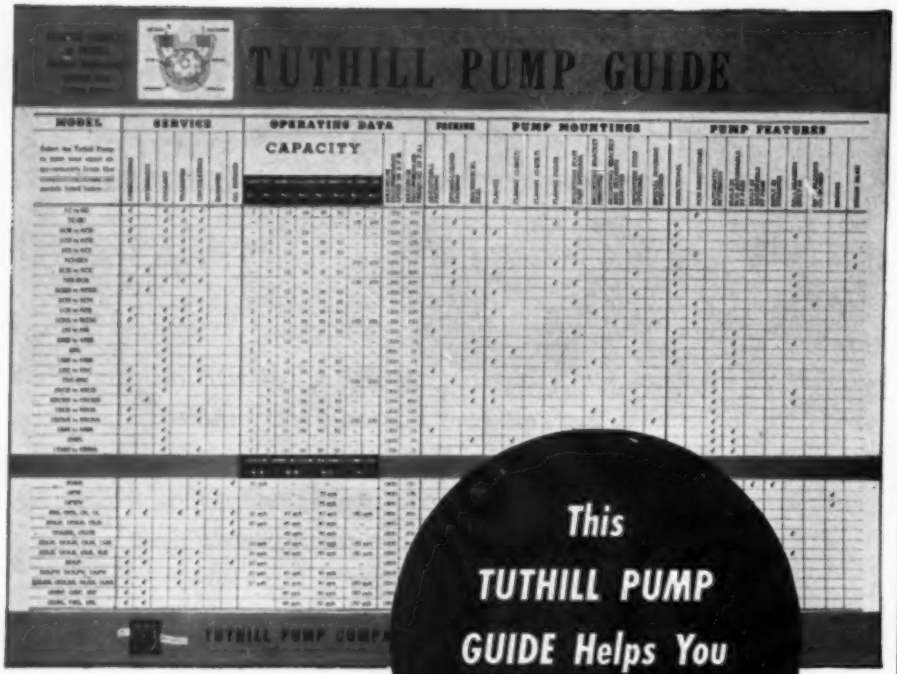

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To save you time and trouble in selecting the pump best-suited to your application, Tuthill engineers have developed this revolutionary new Pump Guide. Here, in one easy-to-use chart, is a volume-full of information on the complete line of Tuthill Pumps.

At a glance, it shows you the services for which each model is built, together with performance characteristics, types of packing, mounting styles and distinctive features that enable you to fit the pump to your need, rather than the need to the pump.

Tuthill Positive Displacement Pumps serve Industry in Lubrication, Hydraulic, Coolant, Oil Burning, Circulating and Transfer Service.

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Circle 83 on Reader Service Card

LITERATURE AND SERVICES OFFERED IN THIS MONTH'S ADS

For more information circle numbers on the reader service card bound in this issue.

LONG LIFE and high efficiency of Tannate leather packings are some of the features described in leather packing data folder, available from J. E. Rhoads & Son.

Circle 66 on Reader Service Card

SOLENOID CONTROLLED pilot operated hydraulic valves are covered in Bulletin No. 15 issued by the Pathon Manufacturing Co. Also obtainable is Bulletin No. 17 containing information on hydraulic cylinders.

Circle 60 on Reader Service Card

LUBRICATION PROBLEMS and their solutions may be found in Blueprint No. 115, which is offered by the Norgren Co.

Circle 54 on Reader Service Card

DEPENDABLE, HIGH SPEED, HEAVY DUTY operation are service characteristics of Stellite solenoids. A complete range of these is illustrated and tabulated in Engineering Bulletin EM-46A, prepared by the National Acme Co.

Circle 50 on Reader Service Card

PRESS LOCK COUPLINGS attached to hose assemblies provide safety, efficiency and economy for all operating and control lines of every type of hydraulic equipment. The Mulconroy Co. has published a catalog illustrating these couplings.

Circle 49 on Reader Service Card

O RING HANDBOOK showing answers to sealing problems is offered by the Precision Rubber Products Co.

Circle 65 on Reader Service Card

PROFITABLE ADVANTAGES of oil purification in hydraulic applications are given in a hydraulic Bulletin of case histories. This is available from the Honan Crane Corp.

Circle 38 on Reader Service Card

Continued on page 23

Literature Offered In This Month's Ads

Continued from page 16

AFTER COOLER manufactured by the Niagara Blower Co. is discussed in a Bulletin available upon request.

Circle 52 on Reader Service Card

HIGH PRESSURE HYDRAULIC CYLINDERS with all their features and advantages for economical production are described by the Miller Motor Co. in illustrated cylinder Bulletins A - 105 and H - 104.

Circle 47 on Reader Service Card

TO SAVE TIME and trouble in the selection of pumps best suited to your need, Tuthill Pump Co. has made available a guide, which shows performance characteristics, types of packing and other distinctive features.

Circle 83 on Reader Service Card

FLEXIBLE SEALING AND NEW CUSHION DESIGN for air cylinders, which insure positive cushion action combined with automatic valving action for fast return stroke. Improved rod packing increases sealing efficiency. These features are described in Bulletin 252 prepared by the Tomkins-Johnson Company.

Circle 81 on Reader Service Card

DRY SEAL THREAD PRESSURE PLUGS are illustrated in literature issued by the Standard Pressed Steel Co., giving a full range of available sizes.

Circle 75 on Reader Service Card

TEST EQUIPMENT manufactured by Greer Hydraulics Inc., is illustrated and discussed in a brochure now available.

Circle 32 on Reader Service Card

VARIOUS MODELS and sizes of air and hydraulic cylinders, to meet every need, are now available and a brochure detailing these has been prepared by Lynair Inc.

Circle 45 on Reader Service Card

INDUSTRIAL TIMERS which can help give faster accurate production are described in General Bulletin 340 issued by the Eagle Signal Corp.

Circle 22 on Reader Service Card

A product designed for Superior Sealing Action and Longer Wear

Parco "O" Rings mean superior sealing action and longer wear whenever and wherever hydraulic equipment is used. The rubber is *specially blended* to meet your individual requirements. Five combinations of synthetic rubber plus natural rubber overcome problems in heat and cold, weathering, flexibility, permeation, resistance to chemicals, solvents and engine oils due to special custom applications.

Requirements for fine tolerances are completely fulfilled. Remember, wherever there's a hydraulic sealing problem in new equipment or maintenance work, the Parco "O" Ring excels. Specify a superior product at no premium to you. All dash numbers of 6227, 6230 and 6290 series for commercial applications or Army-Navy installations to Specifications MIL-P-5516 (6227 and 6230) and MIL-G-5510 (6290) are available from stock. Silastics and other special compounds are available on order.

Catalog and engineering data on request. Write us today.

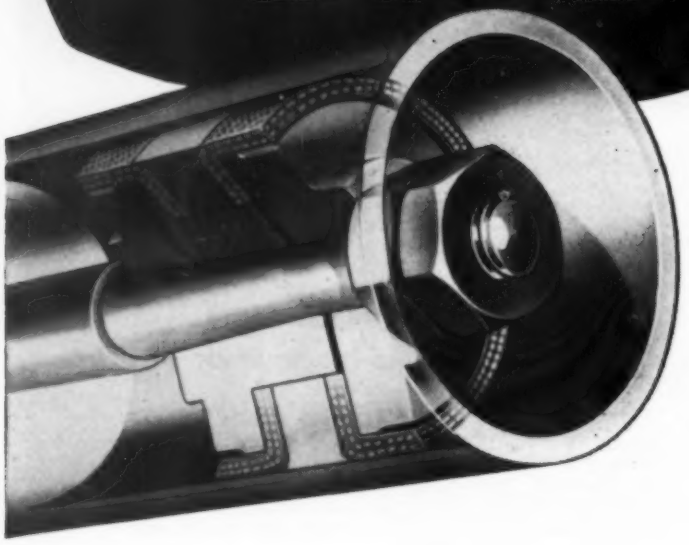
Parco

PLASTIC AND RUBBER PRODUCTS CO.

2100 Hyde Park Boulevard, Los Angeles 47, California
820 North State Street, Chicago, Illinois

Circle 64 on Reader Service Card

YOU GET higher efficiency WITH DARCOVA PUMCUPS ON THE JOB!



THERE are two basic, well-proved reasons why more and more Darcova Pumcups are going into cylinders of air and hydraulic controls and mechanisms.

First, texture-engineered Pumcups outlast most other piston packings at least 3 to 1. There's less replacement, less down-time!

Secondly, efficiency *does not diminish* as Pumcups wear. Response is always faster, surer, with less power consumed!

Darcova Pumcups are available in sizes and engineered textures ideal for virtually any service. Why not find out what they can save *you?*

ASK FOR BULLETIN No. 4502

DARLING VALVE & MANUFACTURING CO.

Williamsport 15, Pa.

DARCOVA® THE ORIGINAL COMPOSITION CUP

PUMCUPS

Circle 16 on Reader Service Card

VALUABLE ENGINEERING diagrams and information are contained in a new Hydraulic Catalog C-800, released by the Eastern Industries Inc. It shows a combination of exclusive features on hydraulic pumps and fluid motors.

Circle 23 on Reader Service Card

QUICK CONNECTING FLUID LINE COUPLINGS are described in a catalog giving complete range of types and sizes. This literature is offered by the Hansen Mfg. Co.

Circle 37 on Reader Service Card

UNFAILING POWER is delivered by the gear pump having perfectly matched gears which permit operation under higher pressures, and insure peak efficiency for a longer time. Catalog H-4 published by the Commercial Shearing and Stamping Co. details these pumps.

Circle 13 on Reader Service Card

TROUBLE-FREE OPERATION, inexpensive, quickly installed and easily maintained are some of the features of the Staynew pipe line filters manufactured by the Dollinger Corp. Bulletin B-1A discusses these double action filters.

Circle 19 on Reader Service Card

ECONOMICAL SERVICE, increased production and other advantages of Ledeen cylinders are outlined in Bulletin 500 available from the Ledeen Mfg. Co.

Circle 41 on Reader Service Card

GREATER VERSATILITY can be found in a 4-way valve which controls water, air, oil, vacuum and gases. An informative folder has been prepared by the Ardee Mfg. Co.

Circle 8 on Reader Service Card

SPECIALLY BLENDED rubber is used for Parco "O" Rings to meet your individual requirements for superior sealing action and longer wear for hydraulic equipment. A catalog and engineering data outlining these "O" Rings are available from the Plastic and Rubber Products Co.

Circle 65 on Reader Service Card

RESPONSIVE TO SETTING CHANGES, the Cono Air Pressure Regulator is outlined in Bulletin PH-10, offered by the Conoflow Corp.

Circle 14 on Reader Service Card

National Conference on Industrial Hydraulics to Participate in Centennial of Engineering

The eighth annual meeting of the National Conference on Industrial Hydraulics will be held on Thursday and Friday, September 4 and 5 and the Sherman Hotel in Chicago. The dates were advanced so that the meeting could form a part of the Centennial of Engineering which will be held during the period of September 3 to 13.

The Centennial of Engineering will mark the 100th anniversary of the founding of the American Society of Civil Engineers, the first national engineering society in the United States. Over 40 national and international engineering societies and associations will participate in their own and inter-society meetings during the eleven days of the Centennial. In addition, a Centennial exhibit will be set up in Chicago's Museum of Science and Industry to give a visual record of the basic principles behind the development of our industries over a century.

An outstanding program is in preparation for the National Conference on Industrial Hydraulics. Speakers and subjects for three of the Conference sessions have been announced. At the pump session John R. English, development engineer, Denison Engineering Company, will speak on "Vane Type Motor Design" and Professor E. L. Midgett, head, Department of Mechanical Engineering, Polytechnic Institute of Brooklyn, will present a paper on "Pump Noises".

At the instrumentation session A. A. Kalinske, director of development, Infilco, Inc., will speak on "Air Operation of Hydraulic Gauges and Controllers in Water Filter Plants" and William A. Theissen, head, Instrument Maintenance, Whiting Refinery, Standard Oil of Indiana, will give a paper on "Instrument Maintenance in an Oil Refinery".

At the automotive session C. W. Lincoln, Saginaw Steering Gear Division, General Motors Corporation, will be heard on "Hydraulic Steering in General Motors Cars" and W. R. Williams, Bendix Aviation Corporation will speak on "Commercial Vehicle and Passenger Car Power Braking".

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Circle 25 on Reader Service Card

NEW! HANNIFIN PRECISION BUILT "Space Saver" HYDRAULIC CYLINDERS

SPECIALLY DESIGNED FOR MACHINE TOOL BUILDERS

When you mount a hydraulic cylinder in a *machine tool,* it *ought* to be good. It *should* be precision engineered . . . quality constructed for long, trouble-free service.

Now, Hannifin offers that kind of hydraulic cylinder in its two compact "Space Saver" lines. Designed by Hannifin Engineers, these cylinders make no compromise with good design—are built to the exacting standards that have made Hannifin Series N cylinders the standard of the industry.

Whether you need these rugged, all-steel hydraulic cylinders for production tools or for machines you build for resale, investigate these new Hannifin designs today!

NEW HANNIFIN TYPE SS "SPACE SAVERS"

9 Bore Sizes, 1½" to 6"—Pressures to 2000 P.S.I.

WHY HANNIFIN "SPACE SAVERS" ARE BEST FOR YOUR MACHINES

Ruggedly constructed in FULL COMPLIANCE with J.I.C. Hydraulic Standards. MULTIPLE seal gland packing removable without disassembling cylinder—UNOBSTRUCTED ports—PRECISION piloting of cylinder body and end caps—pre-stressed tie rods—positive end seals—end caps machined from solid steel—hardened rods available. As in all other Hannifin designs, cylinder walls are "Tru-Bored" and honed; rods are turned, ground and polished; mounting clevises, angles and flanges are sturdy, well designed.

WRITE FOR BULLETIN 111

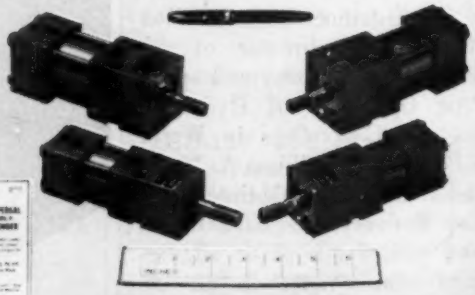
Contains complete construction details and specifications for all models.

NEW UNIVERSAL MODEL U

1", 1¼", 1½" Bores—Pressures to 1000 P.S.I.

IDEAL FOR TOOLING, JIG OR FIXTURE WORK

Compact! The 1" bore cylinder is only 1½" square. Basic cylinder mounts on side or either end—also furnished with mounting flanges or head end clevises. Gland packing and piston seals feature Hannifin's new, thoroughly tested "Lip-seal" packing, which makes it possible for these compact little cylinders to operate on either hydraulic oil or lubricated air. Combines low friction with minimum leakage. Hardened rods standard.



WRITE FOR BULLETIN 112

Complete description and specifications

do ALL you CAN do... with

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Air and Hydraulic Cylinders • Hydraulic Power Units • Pneumatic and Hydraulic Presses • Air Control Valves

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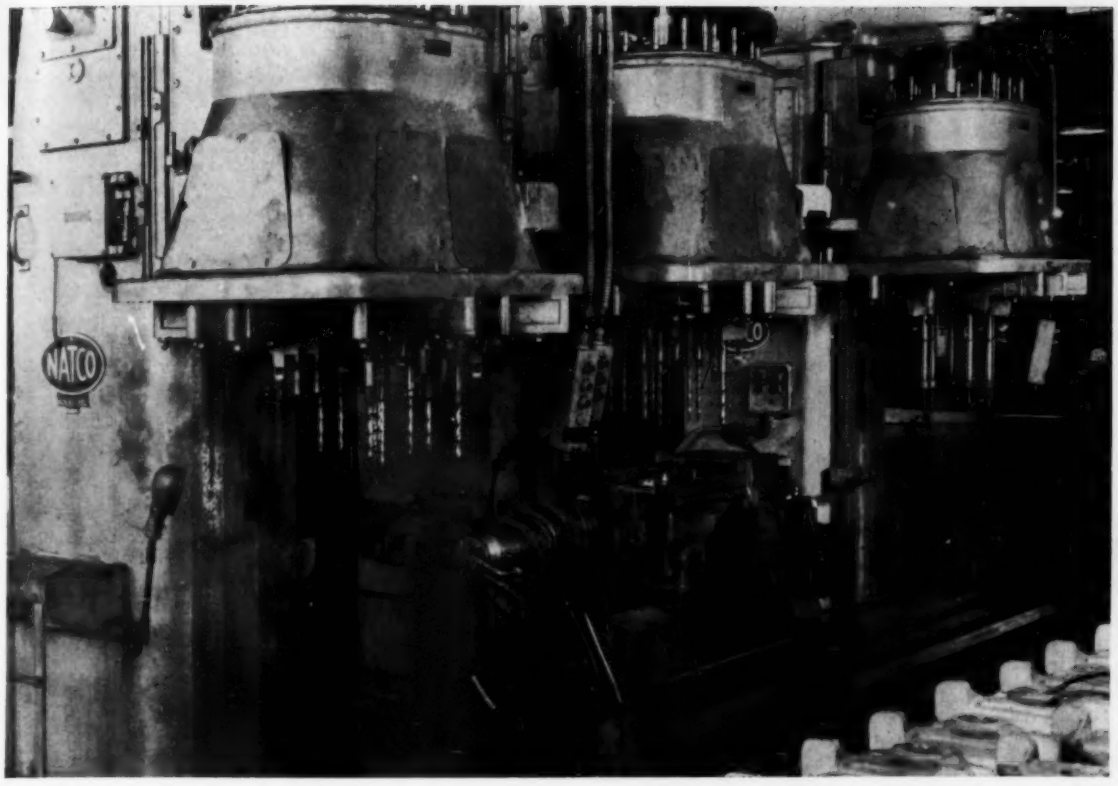


FIG. 1. AIR SHUTTLES this trunnion type fixture between these three machines. The air motor on the fixture rotates the work from load to machining positions.

How Air Circuits Are Used for Production Fixtures

By Phil Lindhuber

TIME and labor needed for handling large transmission housings which require multiple drilling operations have been greatly reduced by the development of an air powered fixture. Starting with the design of a basic drill jig which can quickly and easily be changed to handle a number of transmissions of varying sizes, the Tool Engineering Division of the Spicer Co., Toledo designed an efficient transfer device which automatically moves the work between two Natco multiple spindle drill presses and one multiple spindle tapping machine. The three machines are tied together by square bar rails on top of which travels an air powered trunnion-type fixture.

PHIL LINDHUBER, Chief Tool Designer, Spicer Manufacturing Division, Dana Corporation, Toledo, Ohio

Design of this travelling fixture required a power system which would:

1. Assure proper automatic sequence of operation
2. Provide the necessary rigidity to the workpiece during drilling
3. Offer complete safety to work, equipment and personnel
4. Be simple to maintain
5. Be practical from a cost standpoint.

We selected air power because the required clamping and locating functions could best be done by linear cylinder travel. Air is readily available in our plant and the circuit can be arranged to provide considerable flexibility in a minimum of space. Further, the use of air provides a clean system free from any fire hazard.

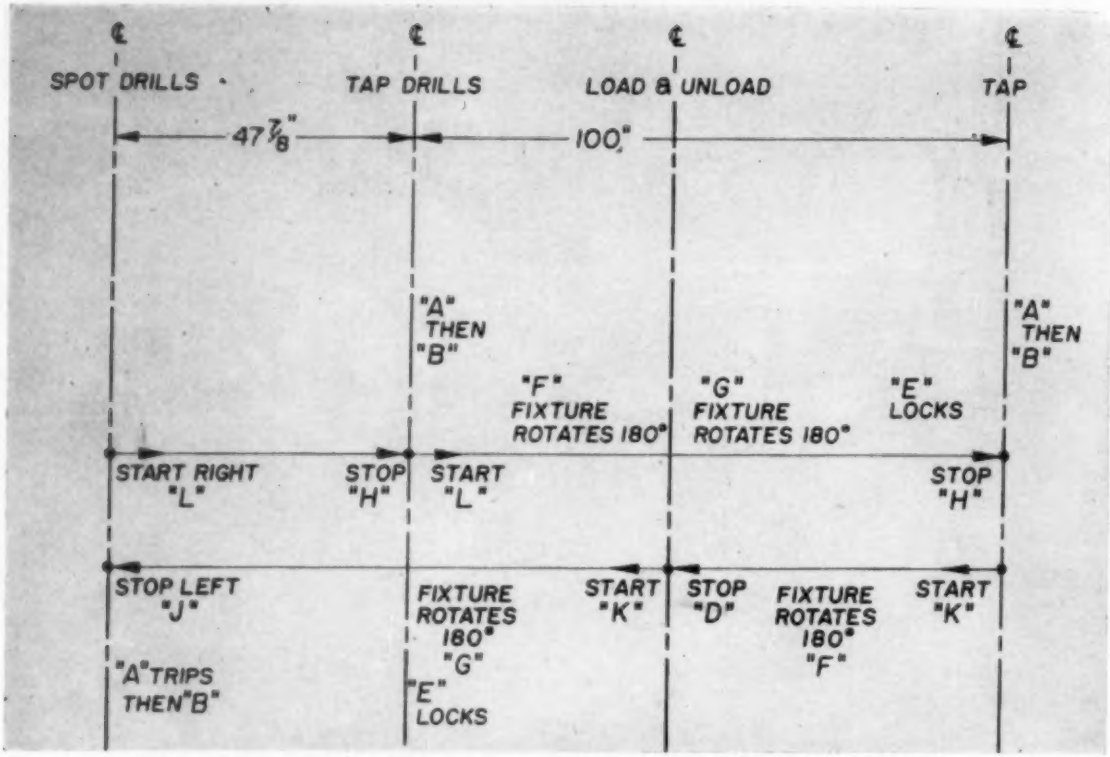


FIG. 2. TRAVEL PATTERN of the fixture is shown on the drawing. Letters show which air valves are actuated by cams at the various fixture positions.

It was decided to actuate all fixture operations by using cam operated pilot valves. While limit switch operation of solenoid air valves was a possible approach, the electrical control relays, solenoids and limit switches which would be required would result in a very costly installation and one which we felt might require expensive maintenance. The great number of valve operations are easily timed with positive mechanical actuation which greatly simplifies the control problem. Limit switch actuation is used to control feeding of the drill heads.

The layout in Figure 2 shows the work movement pattern which the air circuit must provide. The fixture must stop in the load-unload position and it must be rotated so that the work can be removed and replaced. Then the fixture starts to move to the left over to the first drill position. Before it reaches the first drill, the fixture must rotate 180 degrees into the machining position and a fixture lock and alignment pin must operate. At each drill position a locating plunger must operate.

Rotate For Chip Removal

The first machine drills two dowel holes, drills to half depth two mounting holes and spot drills all holes that are to be tap drilled at the next station. After drilling, the fixture starts moving to the right and stops at the second machine where the two dowel holes are reamed, the two mounting holes drill through and the remaining holes are tap drilled. To avoid the necessity of changing any drill bushings between machines, two step sub-land drills are used.

Between the second and third machine the fixture must rotate to dump chips and rotate back to the work position. At the third machine the work is tapped. The fixture then moves to the left back to the unload position. Before it reaches this position the fixture again rotates 180 degrees. Figure 3 shows the fixture turned in the work position and Figure 4 shows the load-unload position.

Pilot and Cam Actuation

Having established the operation pattern shown in Figure 2, it is of course apparent that a trunnion-type fixture was required. The air circuit which was designed for this fixture is shown in Figure 5. Air is supplied to the fixture from a hose reel which winds and unwinds as the fixture moves. Only one solenoid valve is used. This is a three-way valve at the air inlet which is an added safety device in case of current failure. A small reservoir is used to minimize surge or erratic action that might be caused in a fluctuating air supply.

To start the cycle after a housing has been loaded, the operator has only to shift the manual control valve which pulls the fixture clamp shot bolt from the rail and actuates, through a linkage, pilot valve "K" which applies air through the left hand travel valve to the table travel motor. Both motors, one for the table travel and the other for the fixture trunnion are piston type air motors. The table travel motor

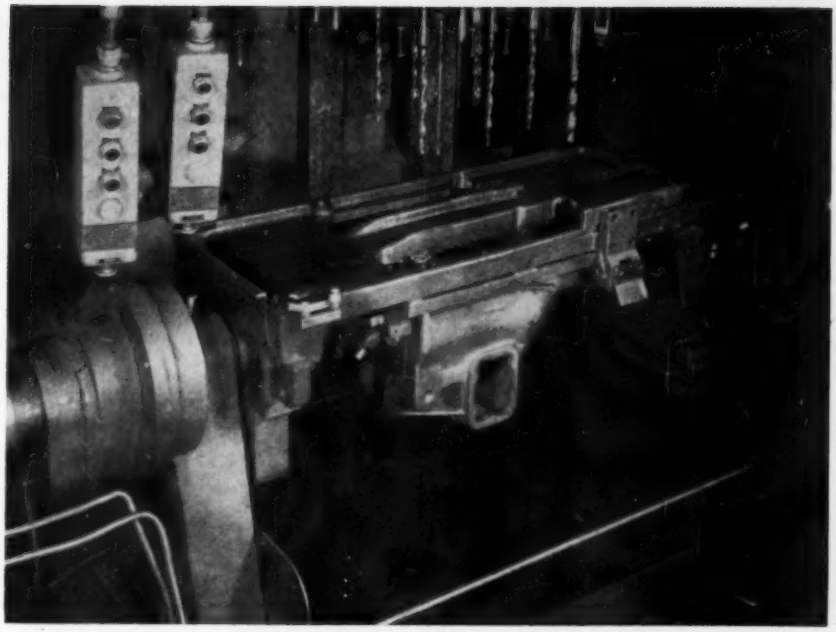


FIG. 3. CLOSEUP of the fixture in the machining position. Directly behind the air motor which rotates the fixture, the fixture lock cylinder is visible. On a bracket at the right is the handle which initiates travel from the load position. Pendant stations are for spindle rotation only.

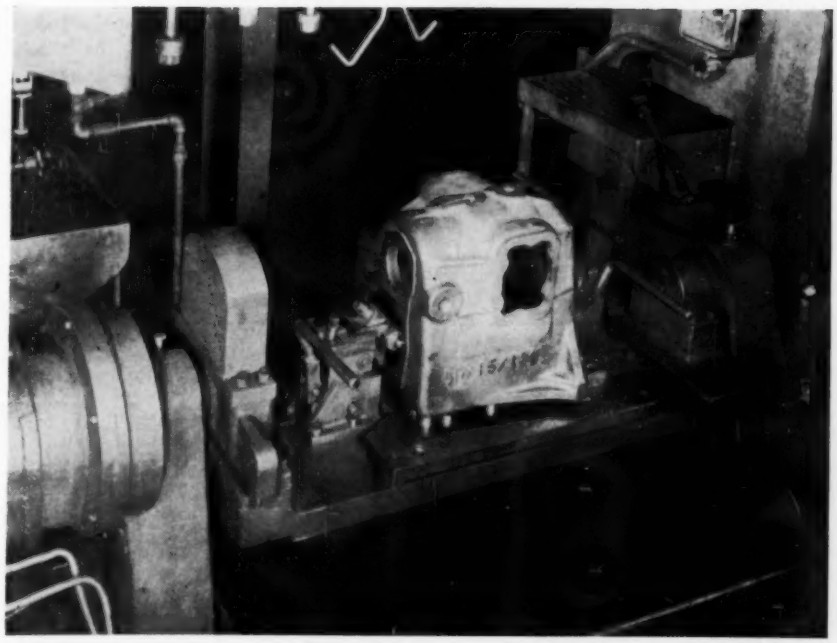


FIG. 4. VIEW OF THE fixture in the load-unload position. The fixture has been designed to handle transmission cases which vary as much as 10 inches in height, 8 inches in width and weigh from 30 to 120 pounds.

rotates a pinion which drives the table through a rack.

Designed for Safety

As the table moves toward the first drill station, a cam trips "G" to cause the trunnion motor to rotate the fixture to work position. Valve "E" is actuated by the fixture rotation and the tapered lock and alignment pin enters to hold the fixture. If the fixture should not rotate into position before passing a drill spindle, emergency stop valve "M" will be tripped by a cam to stop table travel. This safety feature prevents an incorrectly positioned fixture from feeding into and damaging expensive spindles.

At the first drill station, valve "J" is tripped to stop left hand travel and valve "A" is operated to move the locating plunger, at that station. Travel of the locating plunger trips a limit switch which starts the drill head down. Limit switches control the drill feed. When the head retracts, valve "B" is tripped by a cam mounted on the drill head and the locating plunger retracts. Retraction of the locating plunger trips valve "L" open to start the table to the right. At station 2, valve "H" opens to stop travel and the second locating plunger goes into action. Beyond the second station, valve "F" opens and the lock pin pulls out, and the fixture rotates dumping chips from the

You can design your own transfer machine by developing a power circuit to move the work between drilling and tapping operations. Using shop air and ingenious cam actuated valving, the tool designers at Spicer Co. worked out the transfer fixture described in this article. Operation is automatic from load to unload.

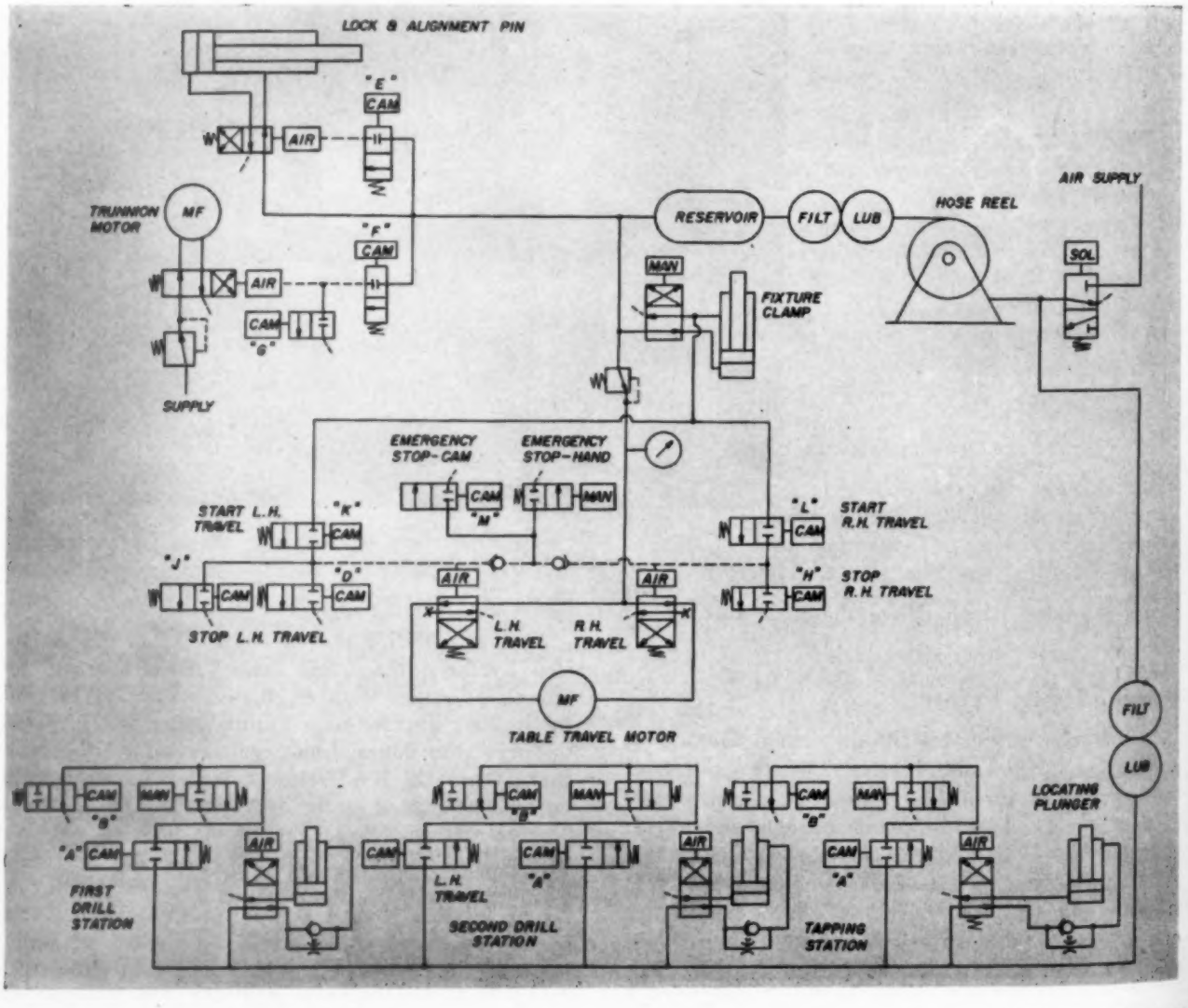
work. Valve "G" trips open to return the fixture to work position, and valve "E" opens to move the lock pin in. The fixture stops and the final tapping is performed. Valve "K" opens after tapping and the fixture rotates and moves to the unload-load position. Moving the manual valve, the operator locks the fixture while he unloads and loads the work.

Two cam valves "A" and "C" are shown in the locating plunger circuit of the second drill. Valve "C" is not used in the set-up that has been described. However, some jobs require stopping at the second spindle while travelling to the left, in which case a cam would be set to trip valve "C".

Fixture travel is at the rate of about 1 fps which is not fast enough to cause any inertia problems. Stop cams are set so that the fixture can easily coast to a positive stop.

The entire cost of air components for this "transfer" machine was approximately $1200. In operation for over three years, the fixture has resulted in a high production rate and has reduced the material handling problem.

FIG. 5. COMPLETE AIR CONTROL circuit for the travelling fixture. Pilot valves are actuated by cams located on the rails, on the locating plungers, on the fixture and on the machine heads.



Sequential Circuit Operates Robot Man

ONE of the outstanding attention getters at the ASTE Show at Chicago in March was the robot man "Luigi", operated at the Rivett Lathe & Grinder, Inc. booth. The all hydraulic, sequential circuit which controlled Luigi's movements was worked out by R. C. Taisey, sales engineer, who also built the exterior wood frame. All of the hydraulic components used were standard units.

At the beginning of his "act" Luigi is seated. He rises and extends his arms in greeting his visitors. He even "winked" for some of his visitors.

Luigi has a steel frame and a window in his chest discloses some of the components that make him tick.

The 600 psi maximum pressure required to move the robot is supplied by a standard package power unit, consisting of a gear pump, ¾ hp motor and a 10 gallon reservoir, mounted immediately behind Luigi's seat. Pressure is supplied through a double solenoid, open spring centered, 4-way valve to the two leg and a hip cylinder. The speed at which the robot moves is controlled by flow control valves. When the leg and hip cylinders have extended, pressure opens through sequence valve A1 to actuate the shoulder cylinder. In turn, as sequence valve A2 is opened, pressure is supplied to the two arm cylinders, extending them.

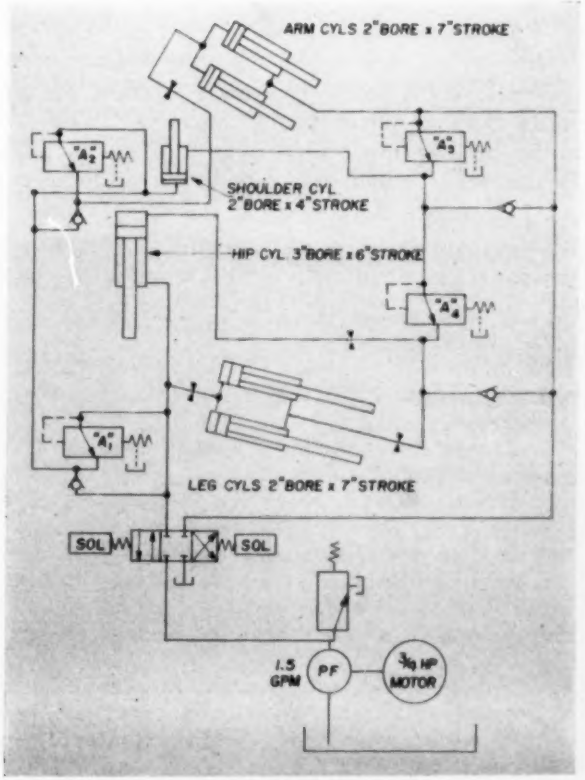
Luigi is seated by the reverse procedure. When the 4-way valve is reversed, the arm cylinders are open to tank, sequence valve A3, in turn, opens shoulder cylinder to return and sequence valve A4 opens the leg and hip cylinders to return. Luigi resumes his seat.

The sequential circuit was chosen to utilize hydraulic components throughout. As shown by the circuit diagram, the arrangement is a basically simple one and adaptable for many purposes. The robot's arms and legs are actuated by 2 inch bore, 7 inch stroke cylinders, the hips by a 3 inch bore, 6 inch stroke cylinder and the shoulders by a 2 inch bore, 4 inch stroke cylinder. Check valves are provided for each sequence valve.

Luigi proved one of the most popular exhibits at the ASTE Show; in addition he was photographed for the daily press and he performed for two television shows, one local and one national.

LUIGI, WHOSE MOVEMENTS are controlled by a sequential hydraulic circuit, is shown greeting a visitor.

THE SEQUENTIAL circuit which operated the robot man.



PIPING POINTERS

for hydraulic circuits

Part 3 of a series on "Good Practices in Designing and Building Hydraulic Power Systems"

By W. T. McCormick

FOR efficient operation and maintenance of hydraulic machinery, circuit layout planning is just as important as the proper selection of components and good reservoir design. Choosing the right components does not assure good design. Even the best pumps and valves will not perform satisfactorily if the circuit is improperly piped.

Final piping of a hydraulic system requires more than a schematic of the circuit. The machine builder must also have a physical piping layout from which the pipe, tube or hose runs

W. T. McCORMICK, Tool Designer, Caterpillar Tractor Company, Peoria, Illinois.

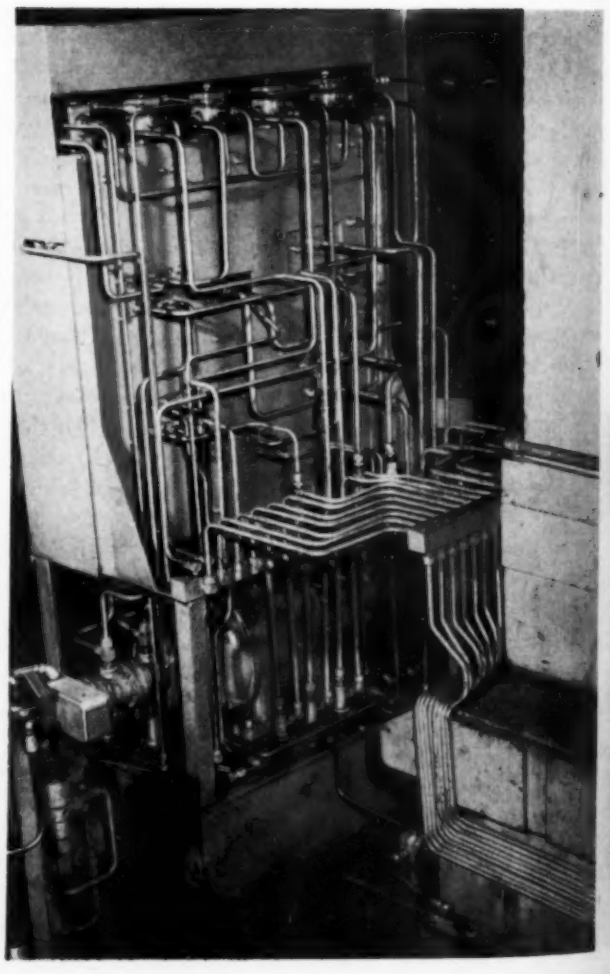


Figure 1:

1. Keep tubing lines horizontal or vertical—avoid diagonals.
2. Locate components to permit tubing bends of sufficient radius.
3. Use manifolds between the machine and control panel.
4. Seal all reservoir penetrations.
5. Provide sufficient clearance between tubes to permit servicing and repair.
6. Converge a series of tubes with a change in direction.
7. Tubes should not obstruct inspection covers. Converging tubes on this machine were permitted to block a cover because two unobstructed covers lead to the same cavity.

Here are three machine tool applications using hydraulic tubing. You'll find that the layout ideas can be profitably applied to your hydraulic circuits. Results will include simpler maintenance, fewer hours of downtime and less leakage.

can be laid out and components put in position.

Circuit layout and construction begins with components in or on machine members. Components should be installed in accordance with the manufacturer's recommendations and specifications. Care should be taken to see that valves are rigidly and securely supported—components should never depend on tubing lines for support.

Industrial applications using petroleum base fluids should use steel tubing. You'll find specified in the J.I.C. Hydraulic Standards that S.A.E. 1010 dead soft, cold drawn seamless steel tubing or equivalent and steel fittings be used; copper tubing or a copper alloy fittings are not permissible with petroleum base fluids. Tubing should be carefully prepared. All internal and external burrs must be removed from tubing and drilled passages. The machine builder will find that time spent to precisely measure and bend tubing will pay off in better appearance, fewer leaks and less scrap tubing. In planning the circuit layout a minimum distance between right angle bends of 10 times the OD of the tube is good practice. A minimum radius for hose should be 9 to 10 times the hose ID, unless manufacturers' specifications permit less. By properly spacing components in a system you can avoid right angle bends which are closer together than the recommended minimum distance.

Horizontal and Vertical Lines: It is recommended that all runs of hydraulic tubing be either vertical or horizontal, Figure 1. When two such lines cross, each must be in a different plane; this eliminates from one to a series of offsets. Horizontal and vertical lines can usually be obtained by one or two additional bends. For example, horizontal and vertical lines are easier to keep away from areas that must not be obstructed, like inspection covers or openings. Experience in planning tubing lines has taught us that lines at diagonals or irregular angles are not "short cuts". We find that ease of installation, maintenance, good appearance and good shop housekeeping are the results of planning horizontal and vertical lines.

Support of Tubing: Tubing should be adequately supported at regular intervals; the intervals between supports depend on the size of tubing, the maximum pressure surges anticipated, the type of control components and the accuracy of movement required.

Continued on page 86

Figure 2:

1. Protect tubing by following the machine contour. Stack the tubes and support them rigidly with clamps as at "B".
2. Separate tubing whenever possible to leave machine openings unobstructed.
3. Terminate external runs of stacked tubing with fittings easily accessible for repair.

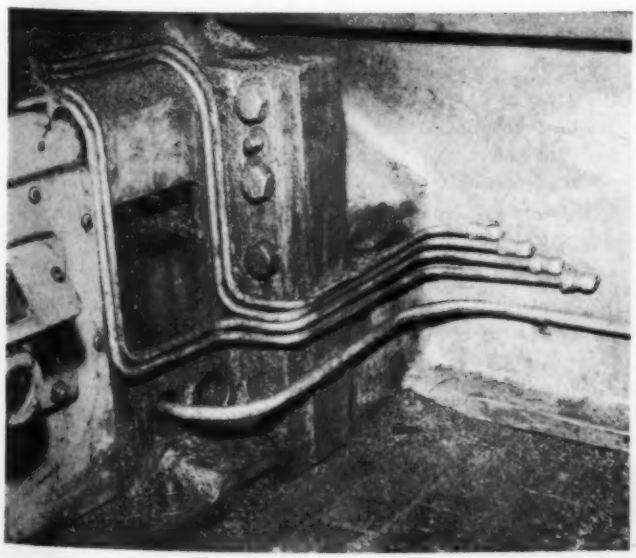
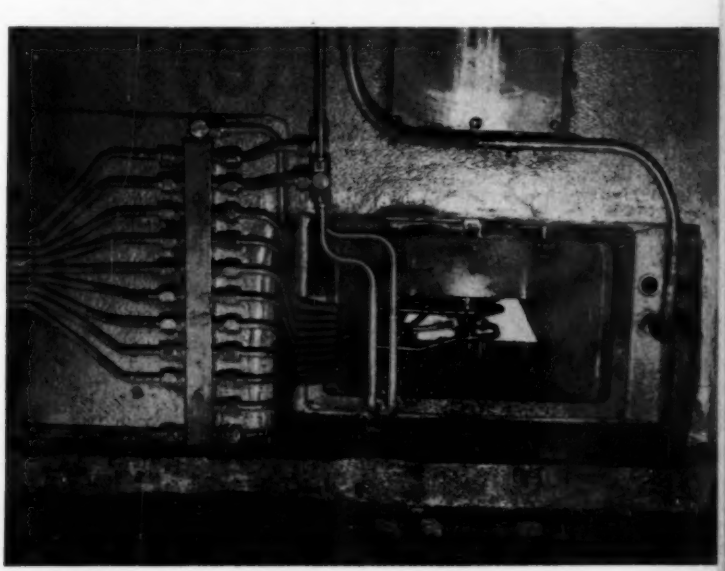


Figure 3:

1. Tubes can be converged in the same plane (left) or with a change in direction (right).
2. Convergence with a change in direction is preferred because it is easier to produce and is usually more accessible for maintenance. When possible fan tails should be avoided because they are difficult to fabricate.



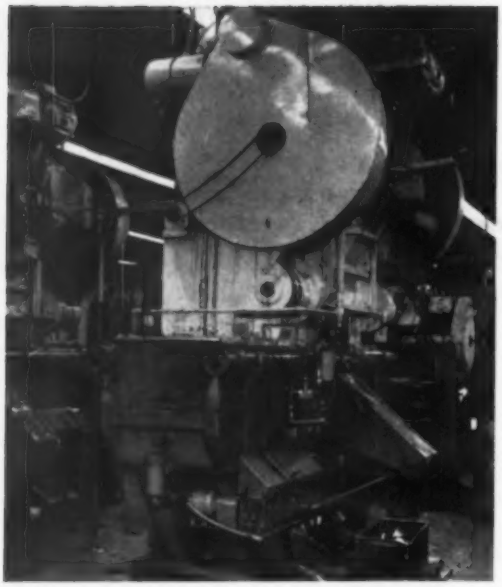


FIG. 1. REAR VIEW of press on which upsetting operating is done. After the upset an air cylinder lifts the bearing free of the die and the piped exhaust tumbles the bearing into the ejection chute. The valving is shown at the side of the ejection chute.

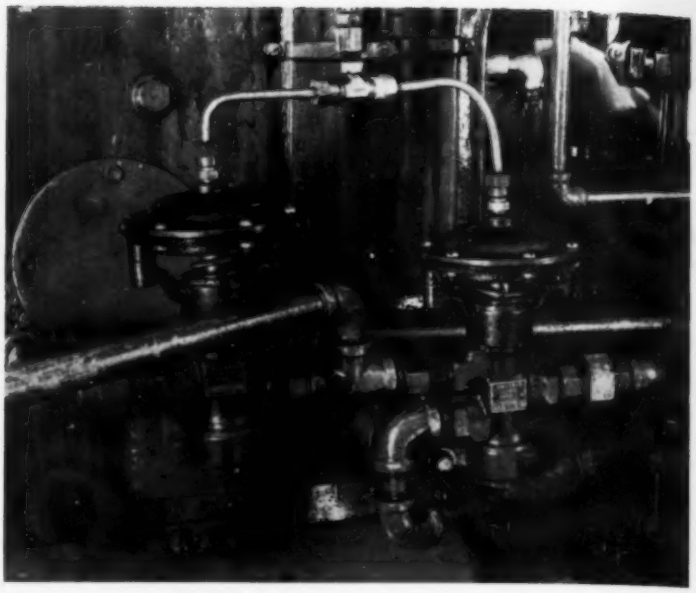


FIG. 2. A CLOSEUP of the arrangement of the two 4-way single diaphragm, pilot operated valves. The left valve is mounted normally; the right valve is mounted upside down with ports reversed. Air piped from the exhause port of the right nand valve tumbles the bearing at the end of the cylinder upstroke.

How AIR POWER step

By Otto Matousek

Superintendent, Maintenance
The Cleveland Graphite Bronze Co.
Cleveland, Ohio

A progressive program of air use in the plant of The Cleveland Graphite Bronze Co. has resulted in an unusually high concentration of pneumatically operated and controlled machines, many of which were specially designed for the purpose. Dividends include circuit simplicity, safety of operation, reduced power and maintenance costs and increased production.

IN the Cleveland Graphite Bronze Company plant in Cleveland, Ohio, air is being used for the actuation of over 95 percent of the work, control and inspection operations. A total of 1700 air outlets deliver 3200 cfm of air from five central station compressors. This remarkable concentration of pneumatic devices has been the result of deliberate selection; the natural advantages of air power have been utilized to an unusual degree. The ingenuity of production engineers and the alertness of well trained maintenance personnel have combined over a 25 year period in achieving an outstanding record in boosting production with air power.

Many of the production machines in this plant have been specially designed and built by this company and in their own shops. This has made it possible to consider air circuits from the beginning for many operations. The "air mindedness" of the company was progressive as the air circuits continued to prove satisfactory.

A selection of three pneumatic circuits on typical machines will be described to give a cross section of the "air mindedness" of this company.

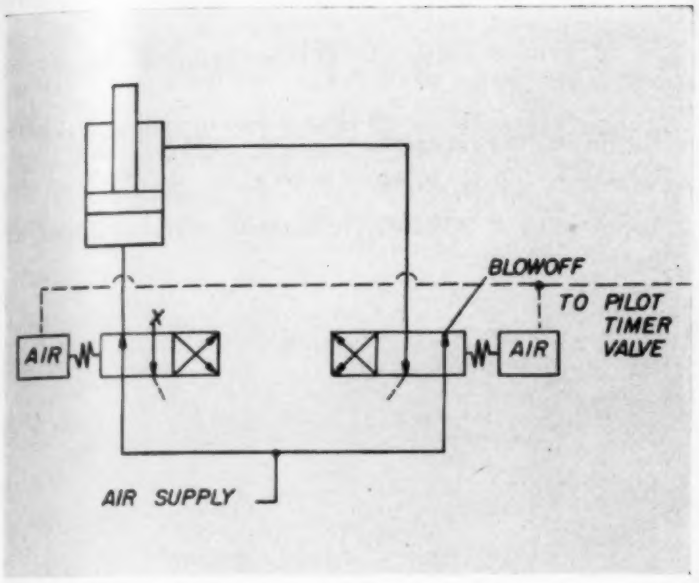


FIG. 3. SCHEMATIC diagram of the air circuit on the upsetting press. Timer valves control the admission of pilot pressure to shift the 4-way valves. The arrangement makes possible the use of air to blow out the work piece after the ejection cylinder has raised the part out of the die. The production of upset bearings was increased 350 percent by the use of air power.

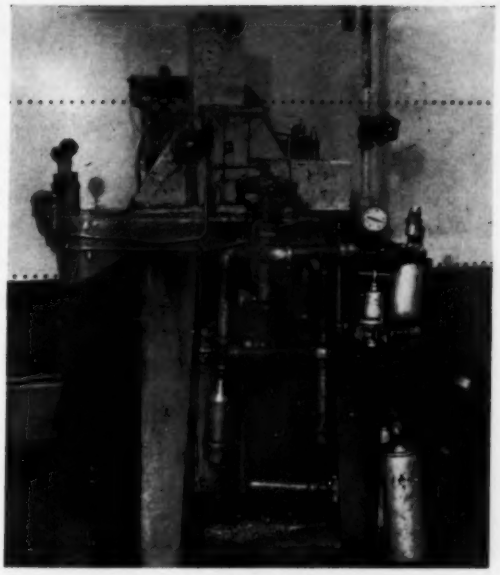


FIG. 4. A SPECIAL BURR filing machine employs air cylinder powered twin cutter wheels for removing burrs. A split pilot circuit has been tied in to the 4-way valve providing two lever control for safety. Air silencers are seen at lower right.

p Production 350-750 Percent

Ejection for Upsetting Press

A very interesting air circuit is used to raise a bearing out of its die after an upsetting operation and eject it out of the rear of the press into a chute. An air jet, actuated at the top of the cylinder stroke, turns the bearing over and flips it into the ejection chute. Figure 1 shows the rear of the press, the ejection chute and the valve assembly.

The air circuit which performs the ejection and kickout consists of two 4-way, pilot operated, single diaphragm valves. A double acting air cylinder is vertically mounted below the lower die bolster. An air pipe exhaust from the normally open valve supplies the blast to tumble the upset bearing.

Figure 2 shows the arrangement of the bracket mounted valves at the back of the machine. The left valve, a 4-way, normally closed valve, is mounted in the normal way, with exhaust port (top) and inport (bottom) at the right and the cylinder port at the left; the right valve is identical except that it is mounted upside down with diaphragm, spring and port arrangements reversed and operates as a normally open valve. The two valves operate together from a pilot timer valve. As pressure is applied, pressure is opened to the cylinder port in the left valve and to port blowoff through a pipe exhaust in the right valve. When the pilot reverses the valves, the left valve is exhausted to atmosphere and pressure is applied to the cylinder port of the right hand valve, returning the cylinder.

This special setup was chosen to get the maximum kickoff for the ejection and to permit two 4-way valves to operate together from a common pilot line, the simplest arrangement.

By actual records, the production of upset bearings was stepped up from 1500 pieces per shift to 7000 pieces—an increase of over 350 percent.

Burr Filing Machine Actuation

A second typical air application for a production operation is the actuation of a burr filing machine. (Figure 4) This unit has a vertically mounted, double acting air cylinder which has its piston end attached to a rack and pinion which turns a shaft on which twin cutter wheels are mounted. A four-way, pipe exhaust,

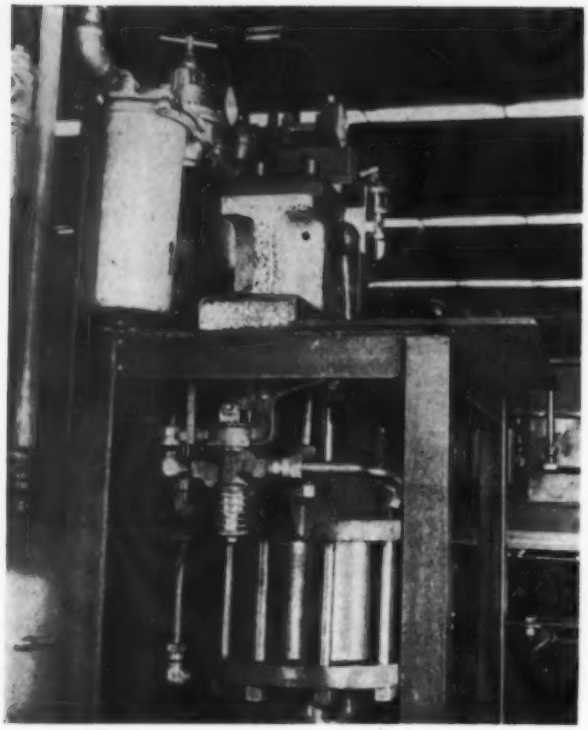
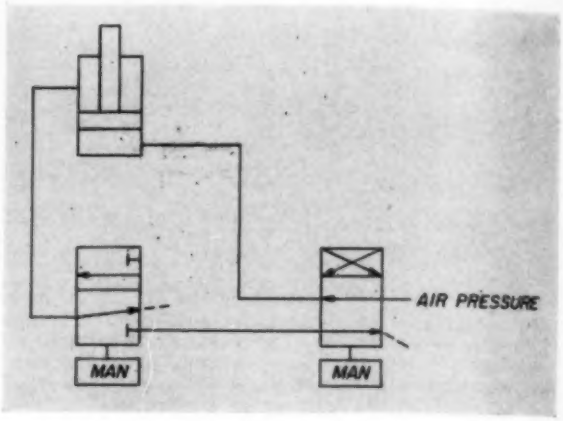


FIG. 5. AIR ACTUATED test fixture in a bench type inspection stand clamps and unclamps a bearing, which is checked for height by an indicating dial gauge. The second valve is used to provide dual lever control for safety.

FIG. 6. SCHEMATIC diagram of the air circuit on the inspection fixture.



diaphragm operated air valve controls the cycle. A pilot circuit with two lever operated pilot valves divides the supply air into two lines which enter the 4-way valve at the diaphragm port and the cylinder port. The two lever operated pilot circuit was provided for safety reasons. This circuit, like many in the same plant, is a closed circuit; the amount of air used is very small, keeping the cost of air to operate very low.

This burr filer regularly handles an average of 17-18 bearings per minute. The hand filing previously required 30 seconds per part, and the services of an expert. The production increase has been up to 750 percent.

Fixture Clamp for Inspection Stand

A third example of an air application is integral with a bench type inspection stand. This unit, Figure 5, checks the height of a parting line on a bearing by means of an indicating dial gauge when the bearing is held seated in the fixture. The air circuit is used to clamp a bearing during the gauge reading.

Two lever operated, spring return valves, one 4-way and one 3-way, raise and lower a double acting cylinder. The clamping is done by an arm attached to the end of the piston rod. Loading is done on the cylinder upstroke and the reading is made on the downstroke.

Two valves are employed to require the use of both hands by the operator in actuating the fixture movement. When the operator moves both valve levers simultaneously, shop line pressure enters the 4-way valve and is ported to the cylinder; the exhaust from the forward end of the cylinder is ported through the 3-way valve to an exhaust port in the 4-way valve. The fixture opens and the operator places a bearing in the fixture. He then reverses his levers. This opens the exhaust port in the 4-way valve, opens the supply or pressure port through the 4-way valve and the cylinder port through the 3-way valve, delivering air to the cylinder port. This lowers the cylinder and closes the fixture on the bearing. The 4-way valve has two exhaust ports, one open from the 3-way valve when the cylinder is raised and the fixture opened, the other from the cylinder port when the cylinder lowers and the fixture is closed.

The examples given also illustrate a common practice in the plant—the use of added valve and pilot circuits to provide two control stations for safety. This also illustrates the flexibility of air circuits and the ease with which added functions are added without complicating the actual circuits.

Many of the special production machines, including the burr filing and inspection units, have been designed and built by the Cleveland Graphite Bronze Co. This has given a maximum opportunity for the consideration of air circuits. A considerable number of special machines have been designed around the simplest, basic air circuits. This has permitted less complicated and less costly machines in many cases.

An important factor, where high production is the rule and where many women operators are employed, is safety. Double valves and pilot circuits offer a simple and foolproof solution to the safe operation of air power circuits.

Another important factor is quality control. Each air cycle exactly reproduces each preceding cycle. Each work operation precisely duplicates itself, reproducing operations to within limits set for the job.

The basic simplicity of air circuits results in easy maintenance. With maintenance personnel skilled in air circuit work, machine down time due to air circuit trouble has been kept very low.

How To Cut Hydraulic Tubing

Part 1 of a series on Fluid Lines

By R. W. Phillips

Project Engineer
The Weatherhead Company
Cleveland, Ohio

This series of articles will attempt to present information of value to the mechanic who is concerned with the installation of fluid lines in hydraulic equipment. The series will cover the following items in the order in which they are listed: (1) *Tubing;* (2) *Tube Fittings;* (3) *Hose;* (4) *Hose End Fittings. A maximum of line drawings, illustrations and other visual means of describing the item, its assembly, or its use, will be employed. It is hoped that they will assist the reader to understand what may not be obvious on the first reading.*

NEARLY all industrial equipment now in service makes some use of fluid lines. Whether these are in the hydraulic system of the equipment or not, the lines must be connected in order to be of any value. The use of both tube fittings and hose assemblies is required. Nearly all devices now used contain groups of mechanical, electrical and hydraulic or fluid controls interconnected. To make collections of devices work properly, it is necessary that all components be used correctly. The writer's observation, over a number of years, indicates considerable bad practice in the use of fluid lines. Many of the bad practices could be corrected or avoided if the recommended and correct procedures outlined in these articles are understood and followed.

This article will cover tube assembly and fabrication. Metal tubes have been used for conducting fluids for many years. In the equipment field, these lines are either pipe or tubing. Since nearly everyone is familiar with pipe, less attention will be paid to it or its fittings; the exception being pipe threaded end connections used as a part of tube fittings.

Roughly, the difference between tubing and piping is, that tubing sizes are made and stated in outside diameter and wall thicknesses, while pipe sizes are based on the size of the hole through the pipe. Neither

FIG. 1. A HACKSAW cut gives a rough edge and is apt to drift. The use of a hacksaw should be restricted to emergency use.

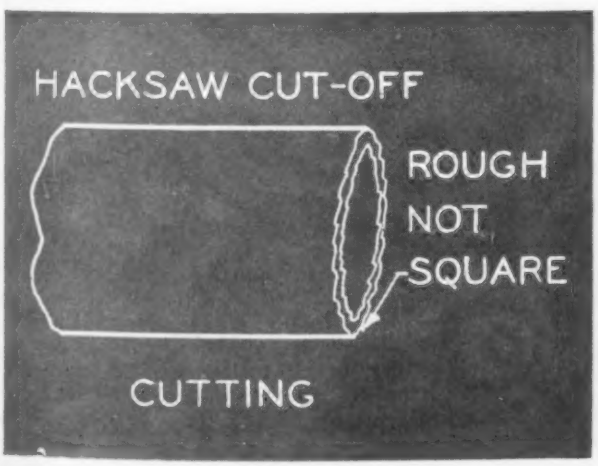
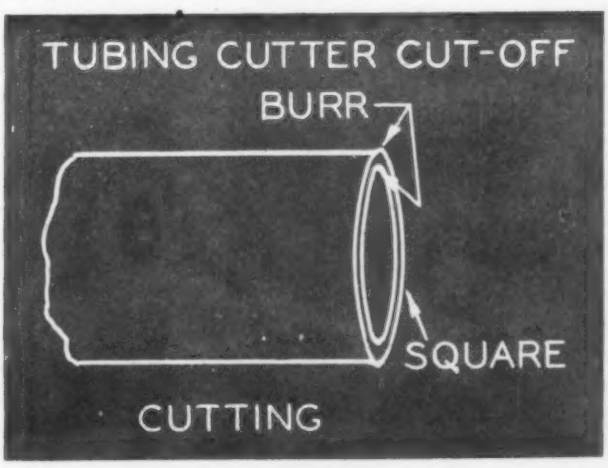


FIG. 2. A TUBING CUTTER produces a square cut-off edge but leaves either or both inside and outside burrs. All outside burrs must be removed; inside burrs, if not excessive on soft tubing to be used with flared fittings, can often be ignored.



of these statements are completely accurate, e.g., extra heavy pipe is smaller in inside diameter than standard pipe, and the British use tubing which maintains a given inside diameter but changes outside diameter with increases in wall thickness. Another distinction is that piping is heavy enough to cut threads into it. The size of tubing is usually designated by giving the outside diameter in inches or fractions and the wall thickness. For example, a ½ inch OD tubing by .042 wall. This is often written as "½ x .042 tubing."

The types of tubing available, and the other necessary information for the use of that tubing, will be discussed in the third article in this series. In this, and the next, article we will try to cover all of the steps which might be necessary for getting a piece of tubing ready to be installed in a fluid system. The operations normally required are cutting, burring, flaring or presetting, bending, etc.

FIG. 5. A STANDARD hand tube cutter may be used to advantage since it assures a square cut and the cutting marks are circumferential. The tendency to heavy up the cut end is an advantage also when the tube is to be flared.

Photo Courtesy The Parker Appliance Co.

Tube Cutting

The first operation in installing a fluid line after the length of the lines have been established by layout or measuring, is cutting off the tubing.

Many times this is accomplished by the use of a hacksaw. If a hacksaw is used, a blade with fine teeth should be used. A good rule is that the two teeth should be equivalent to the wall thickness.

When a hacksaw is used, the cut should be made as squarely as possible. One must remember, however, that the hacksaw blade will drift if the user does not keep the blade square in the frame and watch what is being done. The vise used for holding the tubing can be used as an indicator for a square cut by cutting parallel to its side. Care must be taken not to nick, flatten or distort the tubing while it is being cut. A hacksaw is only an emergency instrument for cutting tubing and its use will, in most cases, damage soft tubing, especially if it is thin walled. Such tubing should be cut with a tubing cutter. It is recommended, however, that a hacksaw be used for cutting stainless steel, because a tubing cutter tends to work harden the ends of the tube, making it more difficult to flare.

The tubing cutter is the best device to use in cuttting a tube, especially if the tubing is to be flared. It also gives a smooth cut, with many marks running circularly around the end of the tube. Such marks do not tend to produce cracks when the tube is flared. Hacksaw marks, which are across the end of the tube, may lead to cracks when an attempt is made to flare the tube.

Power saws, cutting wheels and other cut-off devices may be used for cutting tubing, in addition to the special devices made expressly for the purpose. In general, the action of the hacksaw or the tubing cutter will be produced by the use of these devices. For this reason, the further processing of the tubing can be adequately covered by describing what should be done to prepare these two types of cut-off.

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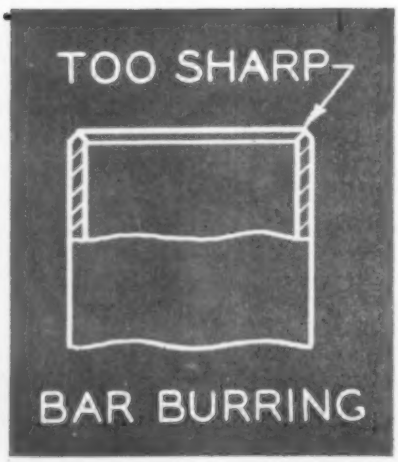


FIG. 3. BURRS MUST be removed to leave a square edge at the end of the tubing. Nicks in the edge must be avoided since these may develop into longitudinal splits.

FIG. 4. A BAD FLARE will result from a sharp edge at the end of the tubing. On flareless fittings a thin edge may dig into the seat or wedge into the counterbore and damage the tube or fitting seat.

How to Determine Cycle Time for Hydraulically Powered Operations

By E. R. Johnson

Hydraulics is being used on multi-operation transfer machines to power transferring, indexing, positively locating and clamping the work and for feeding the tools. Timing and control of each operation must be carefully determined to assure a work rate which will give the correct flow of work in the production line.

Calculating the time required for each operation is not difficult. You need to know a few basic flow relationships and you must carefully consider each operation, being sure to account for every motion. You should also be aware of the limitations of a calculated answer.

Using a typical multi-operation machine as an example, Mr. Johnson describes the circuit and the necessary steps to determine cycle time.

TIME required for an operating cycle which is powered by hydraulic cylinders can *not* be calculated with perfect accuracy. However, by using simple flow equations the designer can determine on paper the approximate cycle time for any hydraulically powered machine. Fortunately it is not usually necessary to compute exact travel rates when using fluid power because it is a simple matter for the designer to provide for varying the machine speeds by introducing a needle or flow control valve. Calculations tell within several percent the expected travel rates. If it is necessary to adjust above or below this rate, within limits, the adjustment can be readily made with valves.

Rate of travel of a hydraulic cylinder depends on the volume of oil supplied to the cylinder per unit time, and the cylinder size. The time required for a cylinder to traverse its stroke is equal to the volume of oil displaced by the piston travel divided by the rate of oil delivery to the cylinder. This rate of oil delivery may be the pump capacity or may be the rate established by a flow control valve setting or valve or pipe capacity.

$$\text{Time} = \frac{\text{volume displaced}}{\text{oil delivery rate}}$$

$$= \frac{\text{cylinder area} \times \text{stroke length}}{\text{oil delivery rate}}$$

$$= \frac{\text{in}^2 \times \text{in}}{\text{in}^3/\text{sec}} = \text{seconds}$$

This simple relationship is all that is required to compute the time for one stroke of a cylinder. Because the formula assumes constant oil delivery rate, the answer is not quite accurate. Cylinder travel is usually cushioned or decelerated by creating a back pres-

E. R. JOHNSON, design engineer, The Morris Machine Tool Co., Cincinnati, Ohio.

COMPUTING CYCLE TIME FOR BRUSHING MACHINE

$$\text{Time} = \frac{\text{Volume Displaced}}{\text{Delivery Rate}}$$

Transfer Cylinder 2" Bore - 38-1/2" Stroke
Pump Delivery 10.9 gpm = 41.9 cu in/sec.

Forward Time $\frac{3.14 \times 38.5}{41.9} = 2.885$ sec.

Return Time $\frac{1.65 \times 38.5}{41.9} = 1.516$ sec.

Locating Pin Cylinder 2" Bore - 1" Stroke
Valve Capacity 3.2 gpm = 12.32 cu in/sec.

Forward $\frac{3.14 \times 1}{12.32} = .254$ sec.

Return $\frac{2.36 \times 1}{12.32} = .191$ sec.

OPERATION	Time (Sec.)	Sec. (For Sw. Oper.)
TRANSFER (Forward)	2.885	
LOCATING DOWELS (In)	.254	.1
LARGE BRUSH (For. - 14-1/2 Stroke)	2.446	.1
LARGE BRUSH (Recip. 4-3/8 Stroke In 4-3/8 Stroke Out Max. 8 Strokes)	10.560	1.6
LARGE BRUSH (Return)	1.931	.1
WORK INDEXES (180°)	2.252	.1
LARGE BRUSH (For. - 14-1/2 Stroke)	2.446	.1
LARGE BRUSH (Recip. 4-3/8 Stroke In 4-3/8 Stroke Out Max. 8 Strokes)	10.560	1.6
LARGE BRUSH (Return)	1.931	.1
WORK INDEXES BACK (180°)	1.778	.1
LOCATING DOWEL (Out)	.191	.1
TOTAL	37.234	4.0
ADD .100 SEC. FOR EACH SWITCH OPERATION	4.000	
TOTAL	41.234	

87.3 per hr. at 100%
65.47 per hr. at 75%

THE SMALL BRUSH FEEDS IN TO DEPTH, DWELLS THEN RETURNS IN LESS TIME THAN LARGE BRUSH

Large Brush Cylinder 3" Bore 14-1/2" Stroke
Pump Delivery 41.9 cu in/sec.

Forward $\frac{7.07 \times 14.5}{41.9} = 2.446$

Reciprocate 4-3/8 inches 8 Times

Forward $\frac{7.07 \times 4.375}{41.9} = .738$ sec.

Retract $\frac{5.58 \times 4.375}{41.9} = .582$ sec.

$8 (.738 + .582) = 10.56$ sec.

Full Return $\frac{5.58 \times 14.5}{41.9} = 1.931$

Clamp Cylinder 2-1/2" Bore - 1/2" Stroke

$\frac{4.91 \times .5}{41.9} = .058$ sec. Clamp

$\frac{3.91 \times .5}{41.9} = .046$ sec. Unclamp

Small Brush 3" Bore - 12-1/4" Stroke

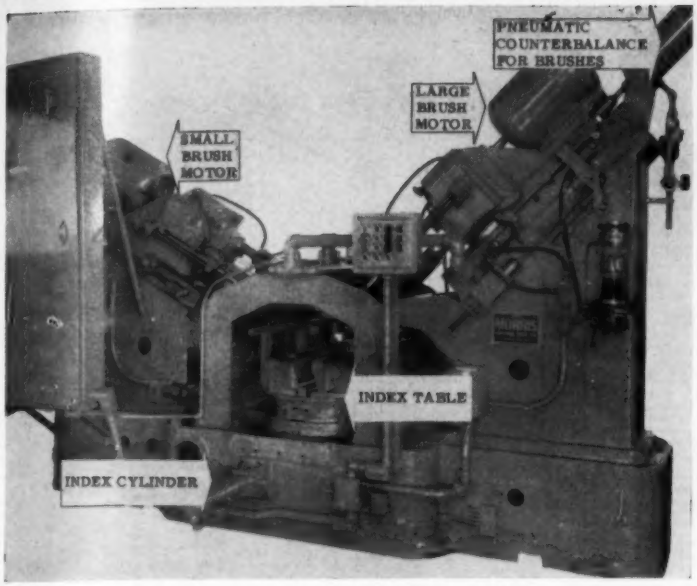
$\frac{7.07 \times 12.25}{41.9} = 2.067$ sec. In

$\frac{5.58 \times 12.25}{41.9} = 1.631$ sec. Out

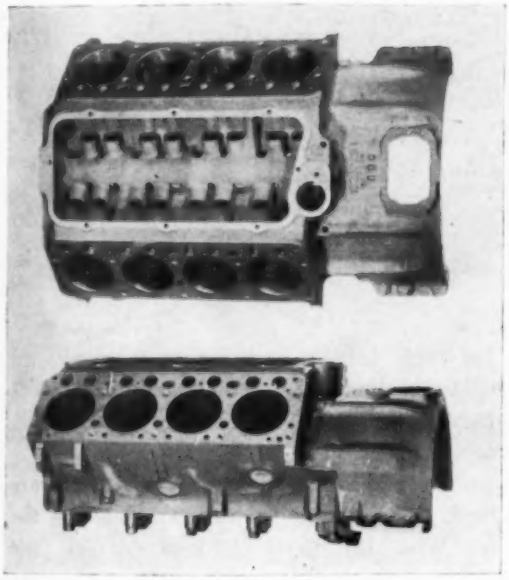
Index Cylinder 3" Bore - 13.35" Stroke

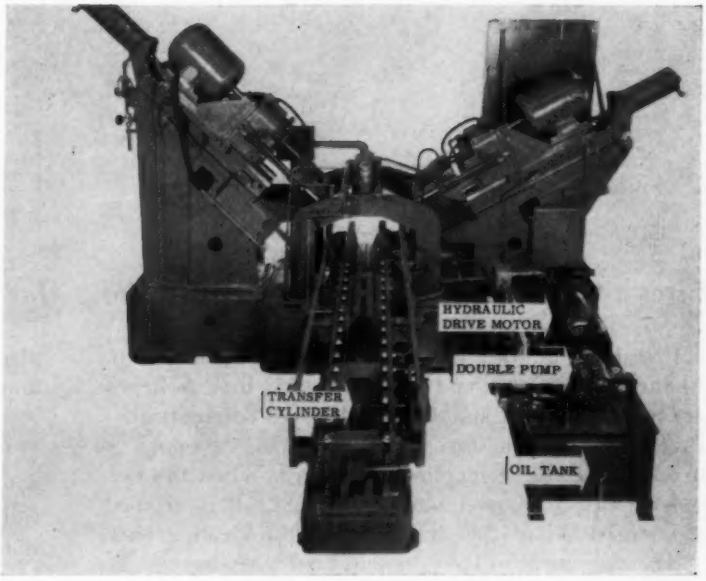
Forward $\frac{7.07 \times 13.35}{41.9} = 2.252$ sec.

Return $\frac{5.58 \times 13.35}{41.9} = 1.78$ sec.



CYCLE TIME is computed for this hydraulically powered brushing machine. The cylinder and tappet bores on the automotive engine block shown here are wire brushed. Oil power positions and clamps the work and feeds the brushes. One hydraulically operated angular slide carries four wire brushes for cylinder bores; the other slide carries eight brushes for the tappet holes. Automatic 180° indexing allows alternate brushing of both cylinder banks.





sure which effectively reduces oil delivery at the end of stroke. Also, if no flow control valve is used, another error may occur when it is assumed that the pump is delivering its rated capacity. This may not be the case if the pump is worn or there is any system leakage.

The size of error introduced by deceleration at the end of the stroke depends upon the length of stroke and frequency of stroke. That is, the longer the stroke and the fewer cycles per minute the less effect deceleration has on our computation. These are the limitations which the designer must be aware of when he makes his timing calculations. There is no simple calculation for taking into account deceleration time. It is pretty much of a cut-and-try operation when it must be critically established. Fortunately, this is not often necessary.

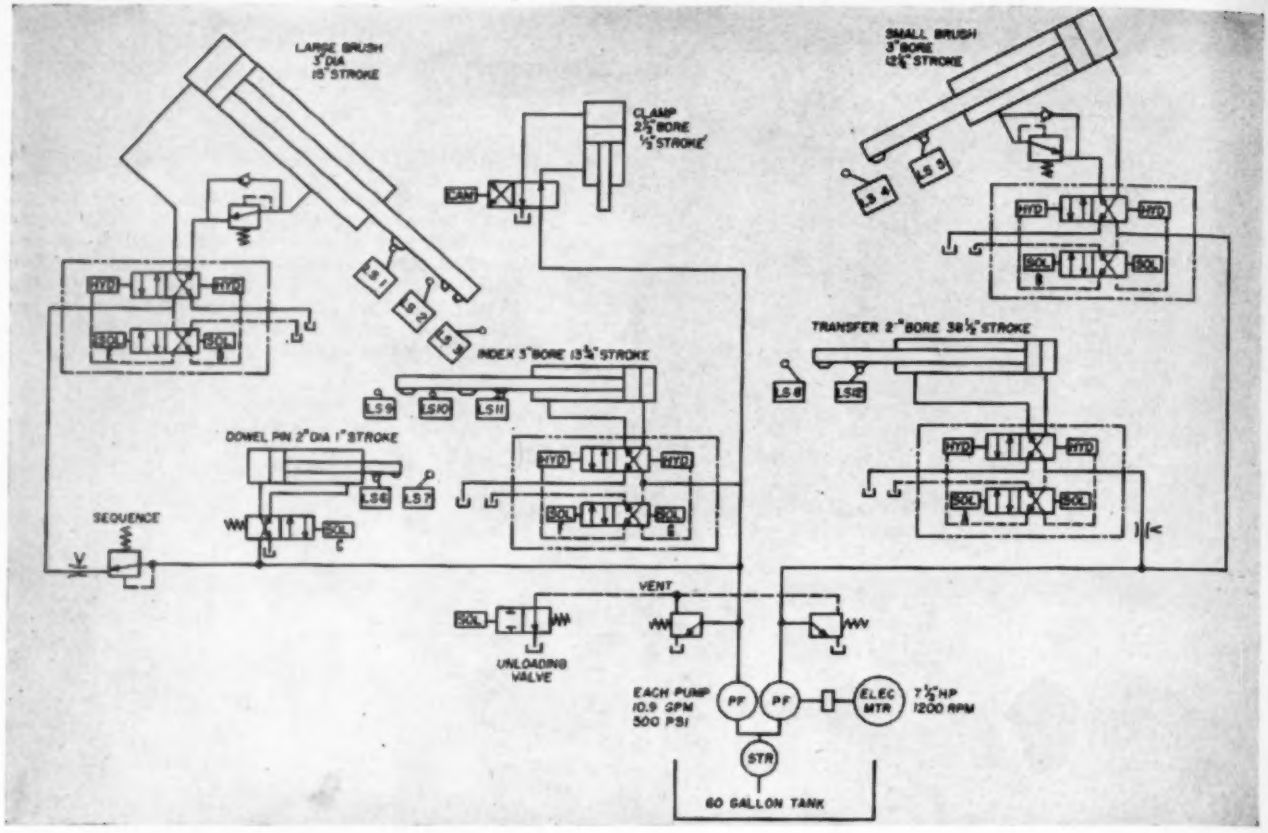
The special brushing machine, built by The Morris Machine Tool Company for use in an automotive production line offers a typical example of a hydraulically powered multi-operation machine.

Six operations are performed by the cylinders seen in the accompanying circuit. Cylinder blocks of the type shown in the photograph are fed to and from the machine on a conveyor. All eight cylinder bores and the sixteen tappet bores must be wire brushed. The brushing operation is performed by rotating brushes which are reciprocated hydraulically in the bores.

By following the operation sequence described with the circuit drawing you can see that our cycle time includes:

1. Transfer of the work
2. Movement of locating dowels
3. Feeding and reciprocating brushes
4. Indexing the work.

Each of these four operations must be broken down into their proper sequence and the time computed. The step-by-step computations are shown in the engi-



Circuit Operation of Cylinder Block Brushing Machine

Pressing the start button starts the double pump. As the brushes enter and leave the work, limit switches are tripped to start and stop the brushes automatically. Pressing the cycle start button energizes solenoid A to move the transfer cylinder forward. When the cylinder block is moved into position, LS-8 is tripped to energize solenoid C and bring up the locating pins.

The movement of the pins trip LS-7 to energize solenoid B and E starting the brush feed cylinders down. Just as the large brush head starts down, the clamp cylinder is actuated by mechanically positioning its control valve and the work is clamped.

When the large brush reaches the bottom of its stroke, LS-3 deenergizes solenoid E and energizes solenoid D to reverse stroke to LS-2 which deenergizes D. The large brushes reciprocate 8 times until an electronic timer times out to return the large brushes to their original position.

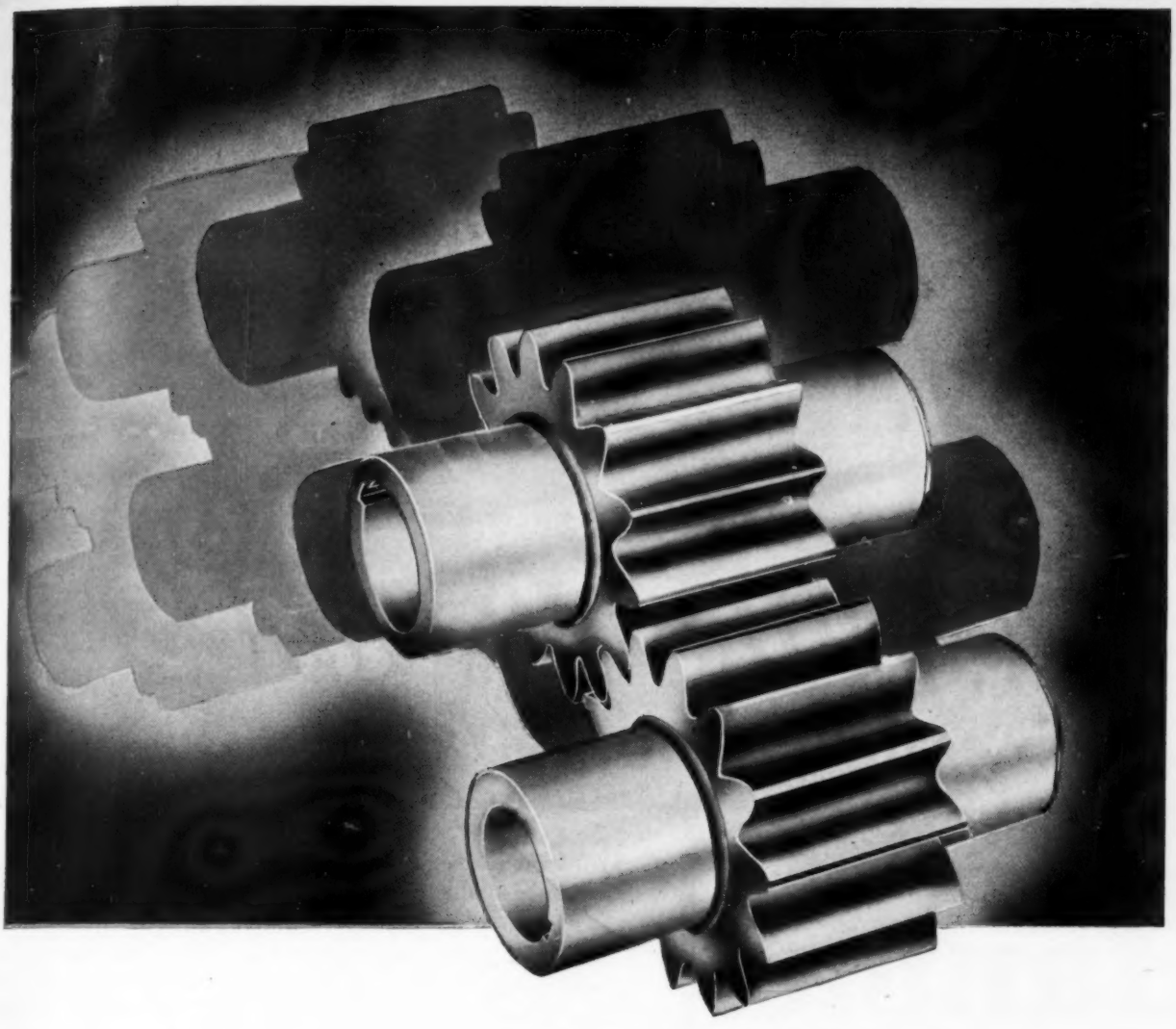
When the small brush head is started by LS-7, it continues to the end of its stroke. When heads are fully returned, solenoid F is energized to operate the index turret. When the turret has indexed 180°, the heads come down for the second brushing operation. After the electronic timer again times out and the heads return, solenoid G is energized to return the index turret. The locating dowel pins retract and the cycle is ready to repeat. When all cylinders are fully retracted, the unloading valve solenoid is deenergized and pressure is removed from the hydraulic system.

---

neering note sheets shown here along with the final complete Operation Time Chart.

The chart includes .100 second for each of the 40 limit switch operations in the cycle. Using a chart shows the operation sequence and indicates that the small brushes feed, dwell and return in less time than the large brushes so the time for this operation should not be included in any overall summation. The final calculation which gives a cycle time of 41.24 seconds per piece tells the production planner that this machine will turn out about 65 work pieces when operated at an efficiency of 75 percent.

We have shown how cycle time is computed using a finished design as our guide. The designer who is given a rate of production which a "yet to be designed" machine must attain, may have to go through similar calculations several times until he arrives at the correct combination of cylinder bores and strokes and pump capacity which will meet all the necessary physical, load and output requirements.



"The Perfect Twins"

These gears will go into Oil Hydraulic Pumps that operate under higher pressures and deliver unfailing power. Twin gears in every "Commercial" pump are the finest gears ground; their perfect tooth contours tightly seal the developed pressure until released. Positive alignment of the meshing teeth is a built-in feature and extra large bearings supporting the shaft ends of each gear keep the "Twins" at peak efficiency for a longer time. The "Twins" are the very heart of the gear type oil hydraulic pump and they must be "Perfect Twins" before they can go into a "Commercial" pump.

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QUALITY IN EVERY TURN

"COMMERCIAL"

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Hanna unitite Valves

YOU want a valve you can *depend* upon to operate faithfully day after day, month after month, year after year—without repacking . . . without adjustment . . . with nothing more than lubrication.

A running test under normal operating conditions shows that a Hanna Unitite Valve is still "going strong" after *10 million cycles of operation,* and should be good for *another 10 million.* Based on eight cycles per minute for an eight-hour day, this would represent 20 years of care-free service!

This is not surprising, for Hanna Unitite Valves are made of superior quality materials and parts. They are packless and permanently tight, protected from dust and abrasive matter by a Neoprene cap, and operate with a patented disc movement.

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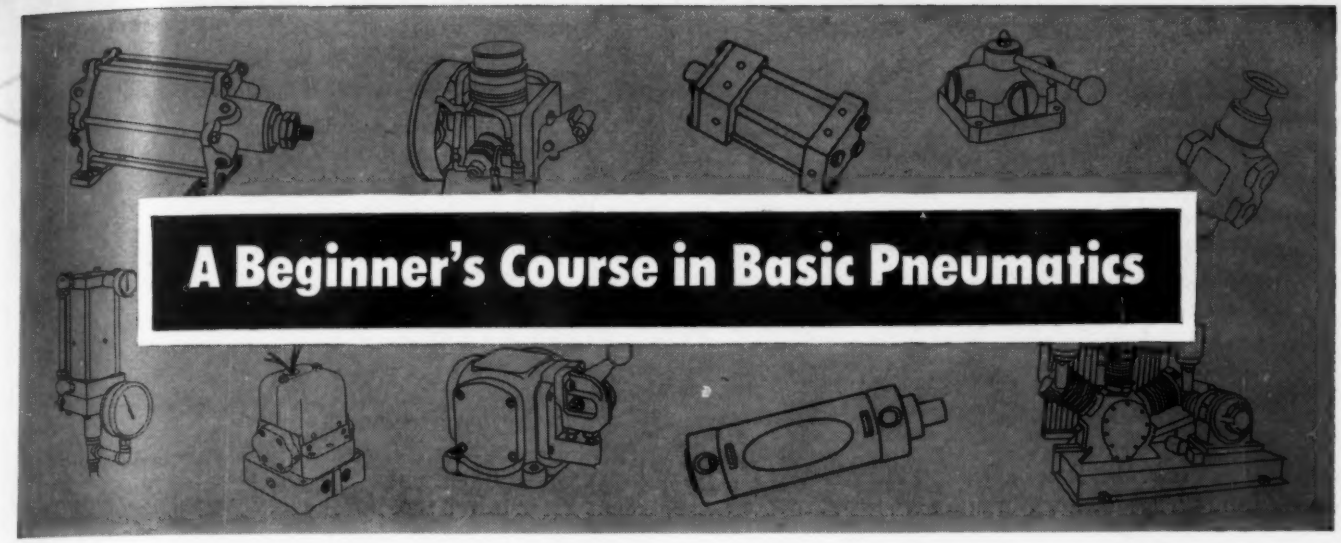

A Beginner's Course in Basic Pneumatics

Section I

Air Properties and Characteristics

Part V

Combination of Boyle's and Charles' Laws

Boyle's and Charles' Laws may be combined for any given weight of air or any other gas. The formula combining these two laws is:

$$\frac{\text{Initial pressure x Initial volume}}{\text{Initial absolute temperature}} = \frac{\text{Final pressure x Final volume}}{\text{Final absolute temperature}}$$

$$\text{or } \frac{IP \times IV}{IT} = \frac{FP \times FV}{FT}, \text{ from which}$$

Final pressure is:

$$\text{(a) } FP = \frac{IP \times IV \times FT}{FV \times IT}$$

final volume is:

$$\text{(b) } FV = \frac{IP \times IV \times FT}{FP \times IT}, \text{ and}$$

Final absolute temperature is:

$$\text{(c) } FT = \frac{FP \times FV \times IT}{IP \times IV}$$

Examples will clarify. (a) 25 cubic feet of air at atmospheric pressure and 60 F is compressed to 15 cubic feet at which the temperature is 200 F. What is the final pressure?

We solve with the formula $FP = \dfrac{IP \times IV \times FT}{FV \times IT}$

IP = 14.7 psi
IV = 25 cu ft
FT = 200 F
IT = 60 F

$$\frac{14.7 \times 25 \times 200}{15 \times 60} = 81.67 \text{ or } 82 \text{ psi final pressure}$$

(b) 30 cubic feet of air at 15 psi gauge and 65 F is compressed to 200 psi gauge and 250 F. What is the final volume?

We solve with the formula $FV = \dfrac{IP \times IV \times FT}{FP \times IT}$

IP = 14.7 plus 15 = 29.7 psi
IV = 30 cu ft
FP = 14.7 plus 200 = 214.7 psi
FT = 250 F plus 460 = 710 F
IT = 60 plus 460 = 520 F

$$\frac{29.7 \times 30 \times 710}{214.7 \times 520} = 5.66 \text{ cu ft final volume}$$

(c) A closed cylinder has a volume of 40 cubic inches. Air at 60 F and atmospheric pressure fills the cylinder. A piston compresses the air ahead of it to 10 cu in. The final pressure, gauge, is 120 psi. What is the final temperature?

We solve with the formula $FT = \dfrac{FP \times FV \times IT}{IP \times IV}$

IP = 14.7 psi absolute
FV = 10 cu in
IT = 60 plus 460 = 520 F absolute temperature
IV = 40 cu in
FP = 120 plus 14.7 = 134.7 psi absolute

$$\frac{134.7 \times 10 \times 520}{14.7 \times 40} =$$

1123.2 F absolute or 663.2 F final temperature.

The Perfect Gas

We are concerned with the relationships of the three variables of pressure, volume and temperature. We know that when any two variables are known, the third may be found; and that when one variable is held constant, the relation of the other two may be found. Air, hydrogen and other fixed gases behave very much like the hypothetical perfect gas over wide temperature ranges. For this reason we will examine the equation for a perfect gas, sometimes called the General Gas Law, in some detail.

The fundamental thermodynamic equation for a perfect gas is:

$$pV = MRT$$

in which the factors are:

p = Absolute pressure in pounds per square foot (144P)
P = Absolute pressure, psi
V = Volume in cubic feet
M = Weight of air in pounds (1 for formula)
T = Absolute temperature, F
R = Experimentally determined constant, representing mechanical work done by the expansion of a unit weight of a perfect gas at constant pressure while heat is added to increase its temperature 1 degree F.

We are already familiar (discussion of Charles' Law) with the factor of 460 for initial and final absolute temperatures. Absolute temperature is −460 F (or −273 C). In air work, the assumption is made that at 32 F the volume of air expands $\frac{1}{492}$ of its volume for 1 degree F rise in temperature from 32 F. Table 1 gives the weight of air at various pressures and temperatures at sea level. This table is based on the perfect gas law, air weight of .08071 pounds per cubic foot at 32 F and barometric pressure of 14.696 psi. From this relationship we determine that the volume of one pound of air at 32 F and 14.7 psi is

$$\left(\frac{1}{.08071}\right) 12.39 \text{ cubic feet.}$$

We are now ready to determine the value of R.

Substituting values in our equation for a perfect gas we have:

$$14.7 \times 144 \times 12.39 = 1 \times R \times 492$$

$$\text{in which } R = \frac{14.7 \times 144 \times 12.39}{1 \times 492} = 53.3$$

$$\text{so that } pV = 53.3\ MT$$

This expresses the relations of volume pressure and temperature and is always true for air.

Continued on page 88

Btu (British thermal units)—the quantity of heat required to raise the temperature of one pound of water one degree F at or near its point of maximum density (38.1F).

Foot pounds—units of work or energy equal to the work done by raising one pound to the height of one foot. In terms of the British gravitational system of units, 778 ft-lbs are equal to one Btu.

Specific heat—a quantity of heat based on the number of Btu needed to raise the temperature of one pound of a given substance one degree F. It includes both the external work and internal work heat.

Specific heat at constant pressure—the heat expended in the change of density of air in performing work.

Specific heat at constant volume—the heat expended in the changing of the temperature of air only.

TABLE I

Temp of Air Deg. Fahr	Gauge Pressure, Pounds																				
	0	5	10	20	30	40	50	60	70	80	90	100	110	120	130	140	150	175	200	225	250	300
	Weight in Pounds per Cubic Foot																					
−20	.0900	.1205	.1515	.2125	.2744	.3380	.3970	.4580	.5190	.5800	.6410	.702	.7635	.825	.886	.948	1.010	1.165	1.318	1.485	1.625	1.930
−10	.0892	.1194	.1493	.2090	.2682	.3292	.3880	.4478	.5078	.5674	.6272	.687	.747	.807	.868	.928	.989	1.139	1.288	1.438	1.588	1.890
0	.0884	.1183	.1485	.2060	.2630	.3218	.3800	.4385	.4970	.5565	.6140	.672	.734	.794	.849	.908	.968	1.114	1.260	1.406	1.553	1.845
10	.0848	.1138	.1425	.1996	.2568	.3145	.3720	.4292	.4863	.5433	.6006	.658	.716	.774	.832	.890	.947	1.090	1.233	1.376	1.520	1.810
20	.0828	.1112	.1395	.1955	.2516	.3071	.3645	.4205	.4770	.5330	.5890	.645	.701	.757	.813	.869	.927	1.067	1.208	1.348	1.489	1.770
30	.0811	.1089	.1368	.1916	.2465	.3015	.3570	.4121	.4672	.5221	.5771	.632	.687	.742	.797	.852	.906	1.046	1.184	1.322	1.460	1.736
40	.0794	.1067	.1338	.1876	.2415	.2954	.3503	.4034	.4574	.5114	.5652	.619	.674	.727	.781	.835	.890	1.025	1.161	1.296	1.431	1.701
50	.0780	.1045	.1310	.1839	.2367	.2905	.3432	.3960	.4487	.5014	.5541	.607	.660	.713	.766	.819	.873	1.006	1.139	1.271	1.403	1.668
60	.0764	.1025	.1282	.1803	.2323	.2840	.3362	.3882	.4402	.4927	.5447	.596	.649	.700	.753	.804	.856	.988	1.116	1.245	1.376	1.636
70	.0750	.1008	.1260	.1770	.2280	.2791	.3302	.3808	.4316	.4824	.5332	.584	.635	.686	.737	.788	.839	.967	1.095	1.223	1.350	1.604
80	.0736	.0988	.1239	.1738	.2237	.2739	.3242	.3739	.4234	.4729	.5224	.572	.622	.673	.723	.774	.824	.949	1.074	1.199	1.325	1.573
90	.0723	.0970	.1218	.1707	.2195	.2688	.3182	.3670	.4154	.4639	.5123	.561	.611	.660	.709	.758	.809	.932	1.054	1.177	1.300	1.544
100	.0710	.0954	.1197	.1676	.2155	.2638	.3122	.3602	.4079	.4553	.5033	.551	.599	.648	.696	.745	.794	.914	1.035	1.155	1.276	1.517
110	.0698	.0937	.1176	.1645	.2115	.2593	.3070	.3542	.4011	.4481	.4950	.542	.589	.637	.685	.732	.780	.898	1.017	1.135	1.254	1.491
120	.0688	.0921	.1156	.1615	.2080	.2549	.3018	.3481	.3944	.4405	.4866	.533	.579	.626	.673	.720	.767	.884	1.001	1.118	1.234	1.466
130	.0674	.0908	.1135	.1580	.2045	.2505	.2966	.3448	.3924	.4396	.4770	.524	.570	.616	.662	.708	.754	.869	.984	1.099	1.214	1.440
140	.0665	.0895	.1115	.1556	.2015	.2465	.2915	.3384	.3853	.4263	.4711	.518	.561	.606	.651	.695	.742	.855	.968	1.081	1.194	1.416
150	.0652	.0874	.1088	.1541	.1995	.2438	.2868	.3308	.3731	.4103	.4624	.508	.553	.596	.640	.685	.720	.841	.953	1.064	1.175	1.393
175	.0638	.0840	.1084	.1482	.1910	.2335	.2755	.3181	.3607	.4053	.4450	.488	.531	.573	.616	.658	.701	.808	.914	1.021	1.128	1.337
200	.0603	.0809	.1014	.1427	.1840	.2248	.2655	.3054	.3473	.3882	.4291	.470	.511	.552	.592	.633	.674	.776	.879	.982	1.084	1.287
225	.0581	.0779	.0978	.1373	.1770	.2163	.2555	.2949	.3344	.3738	.4129	.453	.491	.531	.570	.609	.649	.747	.846	.944	1.043	1.240
250	.0560	.0751	.0941	.1323	.1705	.2085	.2466	.2845	.3232	.3605	.3981	.436	.474	.513	.551	.589	.627	.722	.817	.912	1.007	1.197
275	.0541	.0725	.0910	.1278	.1645	.2011	.2378	.2745	.3111	.3478	.3844	.421	.458	.494	.531	.568	.605	.697	.790	.881	.972	1.156
300	.0523	.0707	.0881	.1237	.1592	.1945	.2300	.2654	.3008	.3362	.3716	.407	.442	.478	.513	.549	.585	.673	.763	.852	.940	1.118
350	.0491	.0658	.0825	.1160	.1495	.1828	.2160	.2492	.2824	.3156	.3488	.382	.415	.449	.483	.516	.549	.632	.715	.799	.883	1.048
400	.0463	.0621	.0779	.1090	.1406	.1720	.2033	.2348	.2661	.2974	.3287	.360	.391	.422	.454	.486	.517	.595	.674	.753	.831	.987
450	.0437	.0586	.0733	.1033	.1330	.1628	.1925	.2220	.2516	.2810	.3108	.340	.369	.399	.429	.458	.488	.562	.637	.711	.786	.934
500	.0414	.0555	.0696	.0978	.1260	.1540	.1820	.2100	.2380	.2660	.2940	.322	.351	.379	.407	.435	.463	.534	.604	.673	.744	.885
550	.0394	.0528	.0661	.0930	.1198	.1464	.1730	.1996	.2262	.2525	.2794	.306	.333	.359	.386	.413	.440	.507	.573	.641	.709	.841
600	.0376	.0504	.0631	.0885	.1140	.1395	.1650	.1904	.2158	.2413	.2668	.292	.317	.343	.368	.393	.419	.483	.547	.611	.675	.801

Based on perfect gas laws and air weight of .08071 lbs. per cu. ft. at 32°F and barometric pressure of 14.696 lbs. per sq. in.

New Flexible Sealing...

T-J AIR CYLINDER

Designed with revolutionary application of

Super-Cushion

It's *sealed with pressure*—a revolutionary T-J application of flexible sealing that insures positive cushion action combined with automatic valving action for fast return stroke . . . eliminates binding and sticking . . . operates with *low friction, minimum wear,* and *added power* due to higher efficiency.

More PLUS features! New type packing nut incorporates a piloted diameter, assuring perfect alignment. Improved rod packing increases sealing efficiency. Piston rod and internal cylinder tube surfaces are hard chrome plated—a standard practice with T-J for over 15 years.

Write for bulletin 252 . . .
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1. Metallic rod scraper to protect rod bearing and packing from dirt and grit.
2. Wrench flats.
3. Self-adjusting chevron type packing.
4. Permanent type adaptor ring.
5. Hi-tensile tie rods.
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8. "O" ring static seal.
9. T-J new flexible cushion seal insures positive cushion with automatic valve action for fast return stroke. (Patent applied for)
10. Fine cushion adjustment.
11. Heavy wall precision honed hard chrome plate.
12. Controlled packing compression with metal to metal contact.

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RIVITORS . . AIR AND HYDRAULIC CYLINDERS . CUTTERS . CLINCHORS

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Positive Torque Control

By Alvin F. Alt

If you have an assembly problem which requires uniform tightening of parts, free from "human error", here's a design which can be applied in your shop. Hydraulically powered assembly machines can be adapted for a wide range of sizes and controlled to give any degree of tightness.

CONTROLLED fluid power offers a safe, consistently accurate means of applying torque for tightening operations. Large torque loads can be applied with very little effort from the operator. Large mechanical levers and heavy wrenches can easily be eliminated.

When an assembly of machined parts is made using threaded connections, the rigidity of the unit depends upon the proper tightening of the threaded parts. On a threaded connection, if the product designer has provided threads of sufficient strength, a good finished product will then depend upon proper assembly methods.

The problem seems simple—"Make the assembly tight enough." What is "tight enough"? It is finger-tight—or wrench-tight—or must we provide a fixed measurable torque which is the same for each assembly?

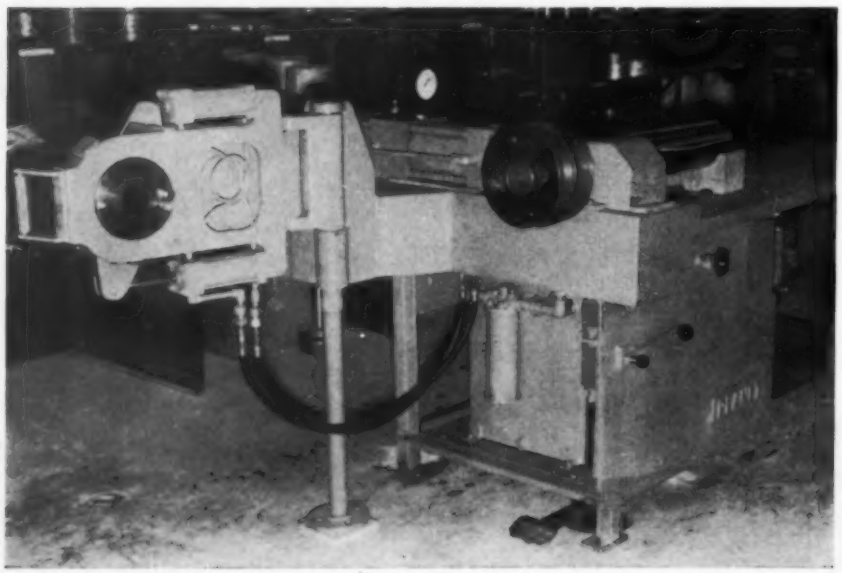
Pictured in this article is one of two special power wrenches built by Planet Products Corporation of Cincinnati for Miller Motor Co. of Chicago. This machine fastens the piston head and rod assembly for large cylinders. For long, efficient operation of any linear cylinder it is important that the piston assembly be rigid when first placed in the cylinder and remains rigid for many thousands of cycles.

ALVIN F. ALT, Chief Engineer, Planet Products Corporation, Cincinnati, Ohio

Eliminates Haphazard Tightening

Because of the continuous cycling which a cylinder must perform, haphazard "wrench tightening" is not permissible. Each head must be fastened with a known torque which will provide an assembly that is tight and in which none of the threads are overstressed.

In making this assembly, the piston rod, having a threaded end, is clamped in the vise. The head is hand threaded onto the rod. The swinging power wrench is then pulled shut with the two spanner pins located in holes in the piston head. Using a foot pedal, the operator then shifts a control valve causing the two opposed wrench cylinders to turn the spanner wrench through a ratchet and pawl mechanism which provides free wrench return. Two cylinders are used to balance the torque lead on the rotary wrench head.



HOSE IS USED to pipe the power wrench cylinders so that the wrench mechanism can swing out on the hinge to permit loading of the piston head and rod assembly.

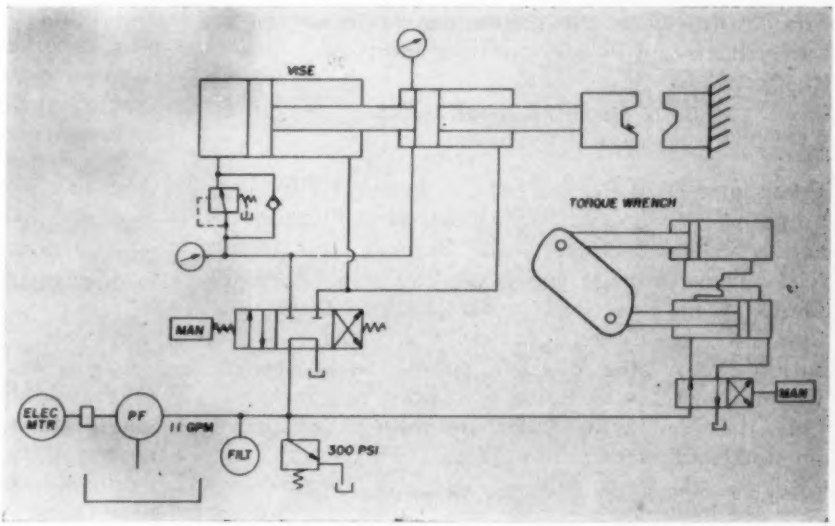
ontr or Assembly of Threaded Parts

Limiting torque is determined by the hydraulic system pressure, the wrench cylinder diameter and the torque arm. On this machine, the torque will reach approximately 22,000 inch pounds at 300 psi. oil pressure. This usually takes only 1½ strokes of the wrench. When this torque is applied, the relief valve will open and the wrench movement stops, telling the operator that the assembly is complete.

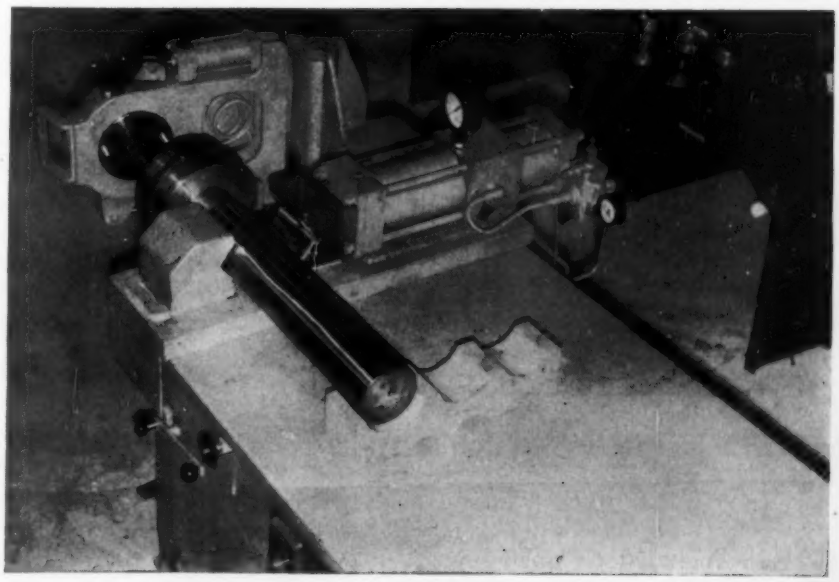
A booster cylinder is used on the vise to give rapid locking travel followed by high force clamping action. The sequence valve permits oil flow to the booster cylinder only after the work is contacted and pressure builds up to open the sequence valve. The vise is controlled from a manual valve. Release of the valve puts the 4-way, three position valve in neutral, trapping oil to hold the vise.

Pressure is adjusted by a handle at the side of the machine which controls the relief valve setting. Pressure gauges give a visual indication of the applied torque.

Although this power wrench was built for a particular line of parts, the principle of torque control with fluid power can readily be applied to solve any similar assembly problem.



A VANE TYPE PUMP supplies oil to the vise cylinder and wrench cylinders. Torque can be regulated by varying the relief valve setting. At 300 psi, a torque of approximately 22,000 in-lbs. is applied.



PISTON ROD and head assemblies are fastened by this torque wrench. A booster cylinder powers the vise which holds the rod while the oil powered spanner wrench locks the head on the rod.

What's NEW in useful Free literature

To get your reference copies use the postcard bound in this issue.

Industrial Fittings . . . A new line of industrial tube fittings is introduced by The Deutsch Company in their Catalog No. 52. This 38 page, spiral bound booklet presents dimensional data on fittings ranging in sizes from ⅛ to 2 in. These fittings are a three piece flared tube design which is widely used on aircraft and industrial hydraulic circuits. More than 25 different styles of fittings are illustrated and the fittings can be supplied in steel, brass, stainless steel or dural. The catalog describes the packaging methods used by Deutsch and pictures part of their shop facilities.

Circle 151 on Reader Service Card

Pneumatic Drill Press Feed . . . Bulletin DF-110, prepared by The Bellows Company, illustrates and describes completely the Bellows drill press feed. This 16 page bulletin shows installation photographs, describes in detail all parts of the feed, includes dimensional drawings and specification data. This 3 color bulletin also shows wiring diagrams and electrical hook-ups to combine the feed with other Bellows "Packaged" pneumatic devices.

Circle 152 on Reader Service Card

Temperature Controls . . . The Burling Instrument Company has published a 12 page illustrated catalog, No. G-17, which describes their full line of temperature controls. Special features of this catalog are the additions of four new instruments and inclusion of tables of application and performance for all instruments. The new additions include the Model V-1C—an electric type with a vapor tight cover; the Model HA—for use in pneumatic systems and the various models Y—temperature controlled valves. Covered also is the tube of Burling Controls for temperatures from minus 300 to plus 1800 degrees F. and in various severe applications.

Circle 153 on Reader Service Card

Speed Reducers . . . New 48 page bulletin describes complete line of De Laval double worm and helical-worm gear speed reducers. Complete Data is included on horsepower, output torque and center distances for reductions up to 6400:1. Detailed information on how to select double reduction gearing, examples of selection, horsepower rating tables, dimension sheets and complete physical data make this an exceptionally useful bulletin.

Circle 154 on Reader Service Card

Hydraulic Valves . . . A new 40 page, 2 color catalog of needle, globe, ball check, relief, and plug valves formerly manufactured by the Parker Appliance Company is offered by the Republic Manufacturing Company to industrial and aircraft valve users. These valves have a range of sizes from ⅛ to 1 in. and are made in brass, aluminum alloy, steel, and stainless steel, depending upon the type and service, for either pipe or tube connection. Present dimensions and high standard of quality are maintained.

Circle 155 on Reader Service Card

Hydraulic Pump/Motor . . . The new 200 psi, single stage, vane type, dual purpose hydraulic power units, built by The Denison Engineering Company, are described in Bulletin P-5. This 8 page bulletin discusses construction, operation as pump and motor, mounting and porting arrangements, and oil specifications. Pump and motor operating characteristics are charted and dimensional drawings are included.

Circle 156 on Reader Service Card

Pipe Identification Markers . . . The W. H. Brady Company, manufacturers of self-sticking industrial products, have published a new 50 page full line product catalog. Products include pipe markers, masks and stencils and printed roll tape. For everyone from the design engineer to plant foreman, the catalog will be recognized as a working hand book depicting through illustrations, specifications and numerous job applications. Each product section in the catalog is tabbed separately. Masks are available in everything from drafting tape on handy dispenser cards, to plastic electrical or fiberglas for special applications.

Circle 157 on Reader Service Card

EXTRUDED BRASS

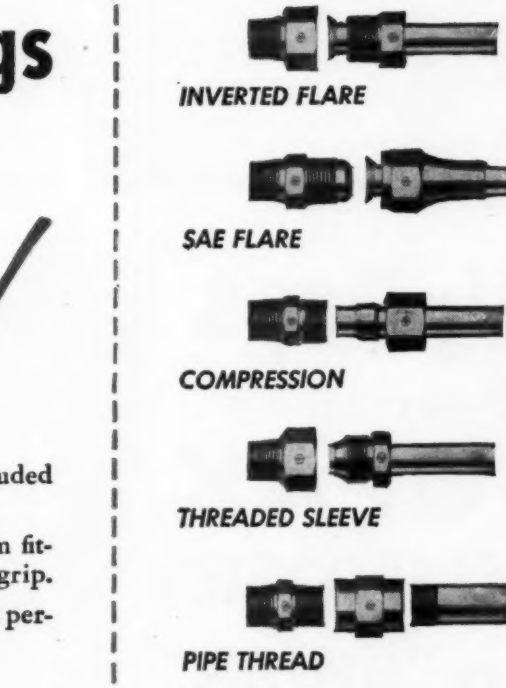
Tube and Pipe Fittings by WEATHERHEAD

3 ways better!

1. NO SEEPAGE—because entire part is machined from extruded bar stock, free from porosity.

2. NO REJECTS—because extruded stock provides a uniform fitting, always with the same angle, always with the same wrench grip.

3. EASIER INSTALLATION—because large, flat wrench pads permit a quick, tight grip, even in hard-to-get-at places.



For complete details ask for Industrial Catalog F-1456.

WRITE: The Weatherhead Company, Dept. A, 300 East 131st St., Cleveland 8, Ohio. In Canada: The Weatherhead Company of Canada, Ltd., St. Thomas, Ontario.

The Mark of Quality

WEATHERHEAD

FIRST IN HYDRAULIC CONNECTIONS

Circle 90 on Reader Service Card

Circle 40 on Reader Service Card

Standard Power Unit . . .

for Furnishing Hydraulic Power to Payoff Reel in Processing Lines

Combination of solenoid controlled relief valve, pressure switch and accumulator maintains constant pressure to keep coil drum expanded and also unloads pump whenever only holding pressure is required.

Unit has sufficient capacity to power all cylinders for coil hoist, traverse, drum expander, shifter for edge alignment. Large reservoir and automatic unloading of pump eliminate need for water cooling coils or heat exchangers.

Your inquiries for custom designed and standard power units will receive immediate attention.

Standard reservoirs in capacities 40, 60, 80, 100, 200, 300, 400, and 600 gallons.

"HYPECO"
HYDRAULIC POWER EQUIPMENT CO.
Custom & Standard Hydraulic Power Units
BOX 431 NORTH LIMA, OHIO PHONE 9-3717
Youngstown Suburb

"O" Ring Engineering Handbook . . . That's the title of a 48 page, spiral bound booklet prepared by Plastic and Rubber Products Company. This handbook provides complete data on material selection, tables of ring and gland dimensions, and design information on both internal and external sealing applications. Sketches illustrate the basic principle of "O" ring seals. Examples will assist you in the determination of ring size and gland dimensioning. The use of backup rings is discussed and other subjects include friction, surface finish, groove location, number of rings per gland, static and rotary seal installations.

Circle 158 on Reader Service Card

Protective Sleeves . . . Gortite-Sleeve protection for all operating equipment is briefly but effectively described in new bulletin just released by A&A Manufacturing Company. Applications are listed for protectors as large as 24 in. diameter and 30 ft. long. All sleeves and boots as specified in the bulletin are fabricated to order from special neoprene material that is impervious to flying chips, oil, grease and water. Gortite-sleeves withstand temperatures within a range of −45 to 220F. without cracking. Common uses listed in bulletin AH-2 include sleeves for hydraulic piston rods, lead screws, safety protection over worm drives, gun mounts, ways on machine tools and for related industrial requirements.

Circle 160 on Reader Service Card

"Air Dogs" Powered by NOPAK CYLINDERS in "UNION" Log Carriage . . .

Illustration shows location of NOPAK Cylinders

Specially built by Union Iron Works is this 6 ft. Band Headrig and Log Carriage, equipped with electric setworks and feedworks, installed at the Smith-Nielsen Mill, Spalding, Idaho. All of the "Air Dogs", however, are actuated by NOPAK Model "E" Air Cylinders, with Pendulum Mounting for oscillating movement.

This is one of many similar applications of NOPAK Cylinders and Valves, in heavy-duty lumber mill equipment. It may suggest how you can use air power effectively in vital machine movements . . . in your plant, or in equipment you build for your customers.

For Technical Data on NOPAK Valves and Cylinders, refer to Sweet's File for Product Designers, or write for Bulletin SW-1.

NOPAK
VALVES AND CYLINDERS
DESIGNED for AIR and HYDRAULIC SERVICE

GALLAND-HENNING MFG. COMPANY
2743 SOUTH 31ST STREET • MILWAUKEE 46, WISCONSIN
Representatives in Principal Cities

Circle 28 on Reader Service Card

IF YOU HAVE FLUID LINES TO CONNECT

YOU'LL SAVE TIME AND TROUBLE WITH

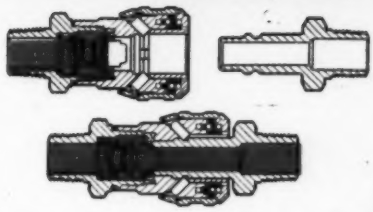
HANSEN

QUICK • CONNECTIVE COUPLINGS

HANSEN PUSH-TITE COUPLING

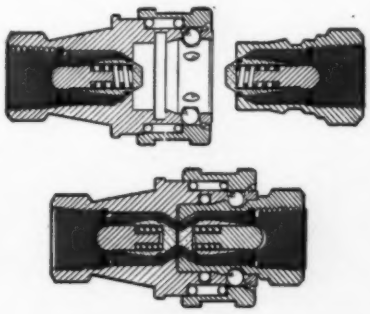
Shuts off one side of line

Gives quick connection and disconnection, with instant automatic flow or shut-off. To connect coupling, and open line to flow of fluid, merely push plug into socket. To disconnect, a slight pull on sleeve releases plug and shuts off supply end of line.



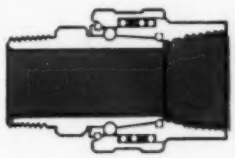
HANSEN HIGH PRESSURE TWO-WAY SHUT-OFF COUPLING

To connect, pull back sleeve and push plug into socket. Identical torpedo type valves permit free flow of gas or liquid through coupling. To disconnect, pull back sleeve..coupling immediately disconnects, valves automatically seal both ends of line. Can be mounted to disconnect automatically where fluid lines may be subject to sudden, damaging strain.



HANSEN STRAIGHT-THROUGH COUPLING

Provides quick connection and disconnection, but does not have shut-off feature. Size range for general use from ¼" to 2½". Two special types of straight-through steam couplings also available—one for low pressures, and one for high pressures.



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for

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OXYGEN • ACETYLENE • GASOLINE
GREASE • COOLANTS • REFRIGERANTS
HYDRAULIC FLUIDS

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TORONTO
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Export Department: CLEVELAND

Write for catalog giving complete range of types and sizes of Hansen Quick-Connective Couplings

THE HANSEN MANUFACTURING COMPANY

4031 WEST 150th STREET • CLEVELAND 11, OHIO

Circle 37 on Reader Service Card

Filtration Equipment . . . A new, four page bulletin offered by the Honan-Crane Corporation, presents in handy, condensed catalog form a complete line of filtration and oil handling equipment for all machine tool and metal working operations. The bulletin features descriptions and illustrations of all types of filtration equipment, including Honan-Crane's self cleaning coolant filter. The bulletin also describes the company's engineering service including design, construction and installation of complete filtration and purification systems for coolants, lubricants and industrial oils used in all metal working operations.

Circle 169 on Reader Service Card

Piston Pumps . . . Here is a very complete booklet, prepared by Dowty Equipment Limited, to describe the design and operation of their Live-Line hydraulic pump. A three dimensional cutaway is used to illustrate the construction of this unique variable volume pump, and drawings clearly show the pumping operation. Working principles are discussed and a simple force diagram explains the automatic device for providing variable volume. Performance data is plotted.

Circle 170 on Reader Service Card

Metallic O-Rings . . . The UAP Wills pressure filled O-ring is described in a folder prepared by United Aircraft Products, Inc. The folder shows a hollow metal O-ring of tubular section, so constructed as to contain an inert gas under pressure. The pressure in the ring is normally about 600 psi. Applications of this ring as a static seal are discussed and sketches show the gland design. A table for standard sizes is included in the folder. An engineering sheet provides groove dimensions and instructions for fitting the ring in the gland.

Circle 171 on Reader Service Card

Air Check Valves . . . The Cornelius Company has issued a Product Data Sheet covering the design and application of their air check valve which is designed specifically for aircraft pneumatic systems. The illustrated features show how the valve seals leak tight and gives straight through uninterrupted air flow which results in high flow capacity with minimum pressure drop. The valve is built to withstand pressures up to 4500 psi without leaking. Complete specifications covering tests, weight, and minimum life are charted.

Circle 172 on Reader Service Card

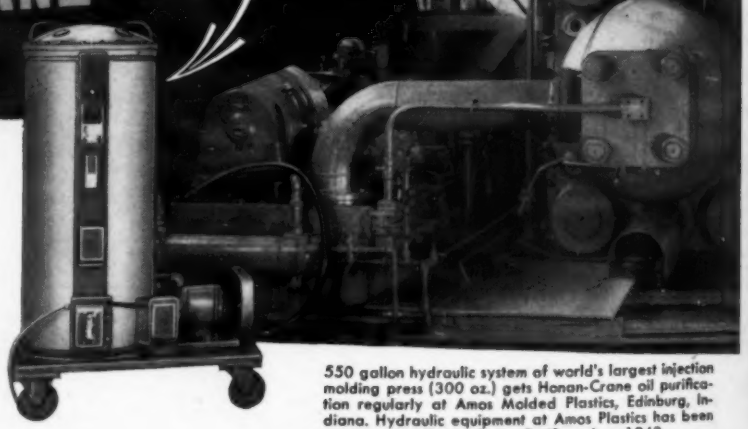
Hydraulic Filters . . . Horizontal plate filters for handling any liquid, are described in an available folder issued by Sparkler Manufacturing Co. The principle of operation is illustrated along with the range of models and sizes. A chart includes specifications on standard sizes.

Circle 173 on Reader Service Card

STOP downtime, costly repairs on HYDRAULIC EQUIPMENT

with World-Famous

HONAN-CRANE oil purification

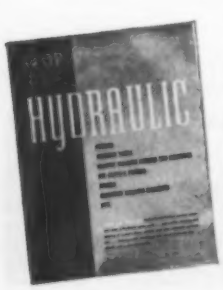


550 gallon hydraulic system of world's largest injection molding press (300 oz.) gets Honan-Crane oil purification regularly at Amos Molded Plastics, Edinburg, Indiana. Hydraulic equipment at Amos Plastics has been protected by Honan-Crane Purifiers since 1942.

70% OF TROUBLE ON HYDRAULIC EQUIPMENT IS CAUSED BY OIL CONTAMINATION AND FAILURE

Honan-Crane Purifiers prevent trouble before it starts in hydraulic installations by keeping oil clean and free from damaging contamination. When used to replace ineffective methods or where no purification program has been practiced previously, 50% reduction in hydraulic maintenance costs and 4 to 5 times the former safe oil life are common experiences.

Honan-Crane Purifiers prevent excessive wear of hydraulic pump parts . . . prevent clogging and sticking of control valves, pistons and other hydraulic mechanisms . . . greatly extend the safe-use life of hydraulic oils. Specify Honan-Crane Oil Purification for your hydraulic equipment. Proven by years of dependable service throughout the world . . . there's no reason to settle for less!



FREE! 8-page "Hydraulic Bulletin" with case histories describing profitable advantages of Honan-Crane Purification in many critical hydraulic applications. Write for your copy!

All Honan-Crane equipment is sold on a performance guaranteed basis

Honan-Crane Corporation

102 Wabash Avenue, Lebanon, Indiana

A Subsidiary of

Houdaille-Hershey Corp.

WORLD'S LEADING OIL FILTER MANUFACTURER

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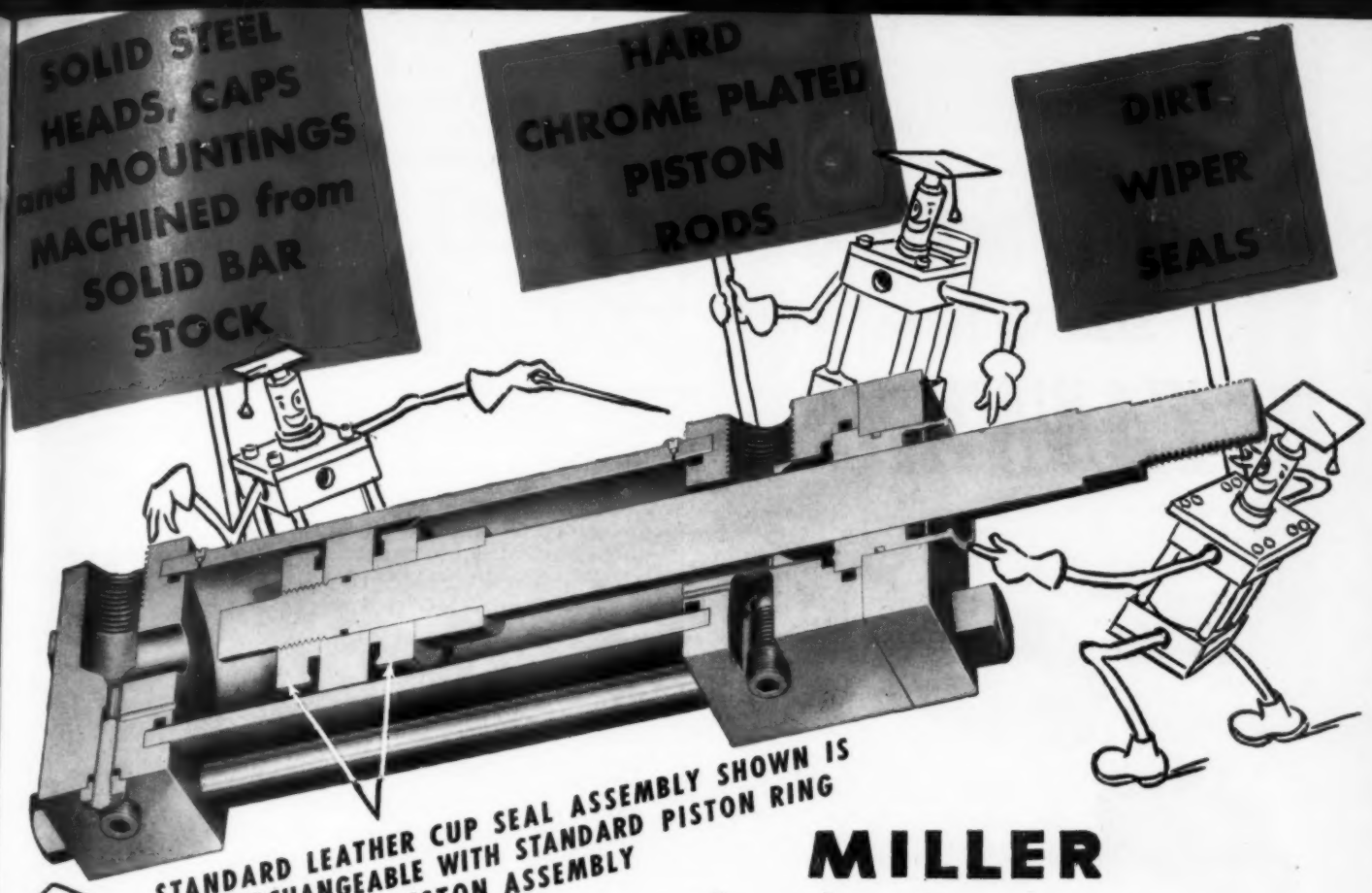
Circle 38 on Reader Service Card

Circle 47 on Reader Service Card



STANDARD LEATHER CUP SEAL ASSEMBLY SHOWN IS INTERCHANGEABLE WITH STANDARD PISTON RING PISTON ASSEMBLY

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High Pressure
HYDRAULIC CYLINDERS

Miller TRADE MARK REGISTERED

Benefits to You

No Broken Castings
No Scratch-Damage to Piston Rods, Bushings and Seals

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To Meet Your

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Cylinder Requirements

. . . now assured by our modern new plant with greatly expanded facilities—devoted exclusively to the manufacture of quality cylinders.

Write for illustrated cylinder bulletins A-105 and H-104

COMPLETE MILLER CYLINDER LINE INCLUDES: AIR CYLINDERS, 1½" to 20" BORES, 200 PSI OPERATION; LO PRESSURE HYDRAULIC CYLINDERS, 1½" TO 6" BORES FOR 500 PSI OPERATION, 8" TO 14" BORES FO 250 PSI; HIGH PRESSURE HYDRAULIC CYLINDERS, 1½" TO 12" BORES, 2000-3000 PSI OPERATION. A MOUNTING STYLES AVAILABLE.

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MILLER MOTOR COMPANY

2008 N. HAWTHORNE — **MELROSE PARK, ILL.**

AIR AND HYDRAULIC CYLINDERS · ACCUMULATORS · COUNTERBALANCE CYLINDERS · HOOSTERS · AIR HOIS

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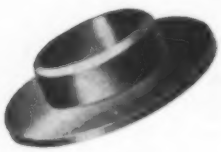
MILWAUKEE — NASHVILLE — SEATTLE — LOS ANGELES — SAN FRANCISCO — BALTIMORE
ST. LOUIS and OTHER AREAS.

Sales and Service from coast to coast

Good Packings

Start With the

TANNING



Because of a series of special tanning processes, exclusively developed by J. E. Rhoads & Sons over the past 250 years, Tannate Leather Packings incorporate many advantages not possessed by other packings. Tannate Packings are inherently resistant to abrasion and wear . . . will not cold-flow, score or abrade. And their low coefficient of friction offers high operating efficiency plus long life. Rhoads Tannate Leather Packings are *all-ways job-engineered* for high temperatures and pressures, and for a variety of services.

Write for Tannate Leather Packings Data Folder to J. E. Rhoads & Sons, 35 N. Sixth St., Philadelphia 6, Pa.

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HYDRAULIC DISCS AND WASHERS

250 J. E. RHOADS & SONS

PHILADELPHIA • NEW YORK

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YEARS PRODUCING FINE LEATHERS

Circle 62 on Reader Service Card

Gear Pumps . . . Two bulletins have been released by the Hydraulic Equipment Company, describing the new Hydreco 2000 series reversible rotation oil hydraulic gear pumps. These bulletins contain illustrations, dimensions and performance data on various types of flange and foot-mounted pumps in capacities from 13 gpm to 25 gpm at 1200 rpm, and 1500 psi. These bulletins are No. 128 and No. 129.

Circle 164 on Reader Service Card

Small Power Units . . . Monarch Road Machinery Company offers a catalog sheet describing their Hy-Lo Jack hydraulic power units. These small units are designed for applications requiring 1,000 psi and one gpm. One basic model is arranged into four available types to meet a variety of applications. One model comes complete with reservoir, pump, directional and overload control valves. Construction features are detailed and specifications are charted for easy selection.

Circle 165 on Reader Service Card

Leather Belting . . . Graton & Knight Company have released a new 40 page belting Catalog and Manual. This is more than just a catalog showing the grades and types of Graton & Knight belts. It also contains such helpful information as how to choose the proper belt for various conditions, how to get longer life from belting, how to make a belt endless—all data of great value to the maintenance man. There are many charts and tables showing horse power ratings, belt speeds, leather belting standards, plus a set of formulas showing the engineer and designer just how to figure their belting for every job.

Circle 166 on Reader Service Card

Air Filter . . . The Hankison Model B-30 Condensifilter, a device which dehydrates and cleans compressed air used for operating instruments, is detailed in a new two-page bulletin published by Hankison Corporation. Measuring only 15 in high by 9 in diameter, the Condensifilter combines in a single compact unit—a mechanical filter, a dehydrator and an automatic trap. When connected to a compressed air line, it removes entrained and vaporized water and oil, oil sludge, scale and other foreign materials from the air. Rated capacity is 30 cfm at 100 psi.

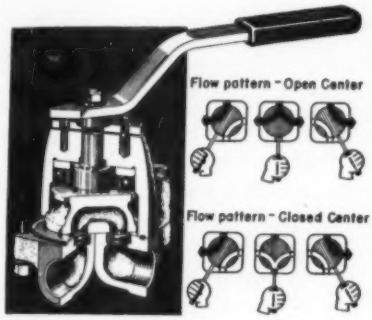
Circle 167 on Reader Service Card

Tension Linkages . . . That's the title of a 16-page booklet available from Chain Belt Company, Baldwin-Duckworth Division. The basic purpose of "Tension Linkages" is to help compare the relative advantages of various type chains for use in tension linkage applications. A handy working load table plus detailed dimensional information and selection procedure are included. A number of interesting application examples as well as illustrations are also shown.

Circle 168 on Reader Service Card

What's NEW in Components for fluid power systems

For more information about these products use the postcard bound in this issue



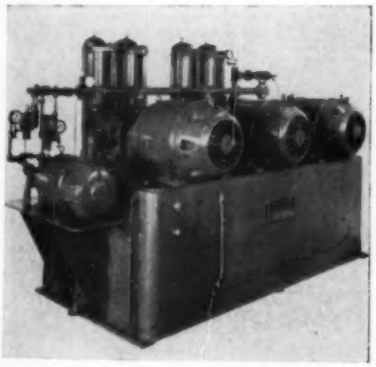
Control Valve for 3000 psi Service

Barksdale Valves
Los Angeles, California

Sizes: Valves come in normally open and normally closed flow patterns from ¼ to 1 in pipe sizes, and for manifold mounting.

Features: The three dimensional cross section illustrates the Shear-Seal principle. The tubular sealing members are so designed that they maintain a balance between the line pressure and the sealing force. Actuation of the valve takes place along the path of least resistance, by shearing the stream between two lapped members. This, in conjunction with generous ball bearings in the valve housing accomplishes extremely free handle movement for manipulating valves furnish hydraulic power and control for maintaining strip edge register.

Circle 201 on Reader Service Card



Hydraulic Power Unit

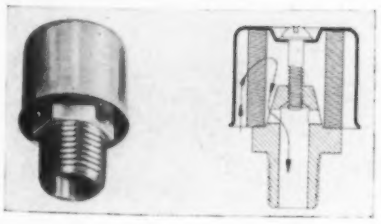
Hydraulic Power Equipment Co.
North Lima, Ohio

Service: The unit pictured here supplies hydraulic power for payoff and tension reels in steel plant processing lines.

Design: Two of the main pumps are used for operation, the third for standby service. The small auxiliary pump and accompany-

Specifications: Tank capacity is 600 gallons, pump capacity 3-60 gpm. Control of accumulator circuit and unloading of pumps during idle cycle is by means of pressure switch and solenoid controlled relief valves at each pump.

Circle 202 on Reader Service Card



Air Vent Filters

Skinner Purifiers Division of Bendix Aviation Corporation
Detroit, Michigan

Sizes: ¼, ½ and ¾ pipe thread.
Performance: Provides approximately 40 micron filtration.

Application: Hydraulic systems, air compressor intake, carburetor intake for small gasoline engines, crankcase ventilation, pneumatic cylinders, fuel tank breather and pneumatic instruments.

Circle 203 on Reader Service Card

Press Control

Emmet Machine & Manufacturing, Inc. Akron, Ohio

Designation: Type E 304 Robotron
Applications: Control of hydraulic presses where press "breathing" or "bumping" is essential.
Design: A complete package unit, it includes operating pushbuttons, lockable keyboard cover, solenoid valve and internal pressure switch. Control of press operations is affected through timing by a synchronous motor with telephone type selector switches and a heavy duty power relay on the output circuit.

Circle 204 on Reader Service Card

JUNK THESE CUMBERSOME CONTRAPTIONS...

GO MODERN-GO VARIDRIVE

You simply turn a control handle. Instantly the speed of the Varidrive changes to the exact rpm you want. You don't have to resort to the use of external speed changers, gear boxes, rheostats, controllers and other contraptions. The U.S. Varidrive Motor occupies little more space than an ordinary motor.

Instant speed change
2 to 10,000 rpm
¼ to 50 h.p.
Quiet, shockless
Available with internal gear reductions
Asbestos-protected windings

U.S. VARIDRIVE MOTOR

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Interestingly illustrated, 16-page book in full color. Presents different types of Varidrives. Tells how you can speed up production 10% to 30%. Mail coupon today.

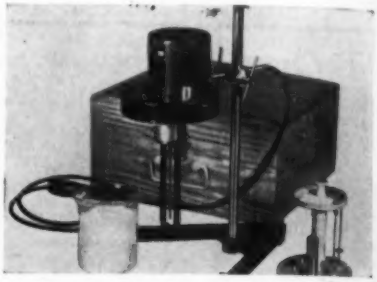
REQUEST FOR 16-PAGE VARIDRIVE BULLETIN
U. S. Electrical Motors Inc. AP-6
Los Angeles 54, Calif. (Box 2058) Milford, Conn.
NAME
COMPANY
ADDRESS
CITY ZONE STATE

Circle 84 on Reader Service Card

Viscometers

Brookfield Engineering Laboratories, Inc., Stoughton, Massachusetts

Designation: Model LVT
Service: For industrial and laboratory measurement of viscosity between .5 cps and 2,000,000 cps.



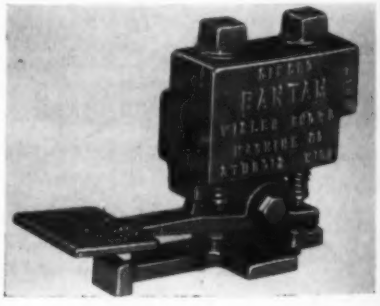
Features: Unit is portable; may be secured with explosion-proof construction when desired.
Operation: Applies the principle of measuring with a calibrated spring the torque on a spindle rotating at a constant speed. Determinations are secured directly in centipoises.

Circle 205 on Reader Service Card

4-Way Air Valve

Wisler Engineering & Machine Co. Sturgis, Michigan

Designation: Sincro Bantam
Size: Line and cylinder ports are tapped ¼ in NPT; overall size, 4 in high and 5¾ in long.



Features: May be supplied with foot, hand or cam levers; 4-way, 3-way normally open or 3-way normally closed with speed control in either or both directions. Neoprene poppet valves seal against brass and stainless steel seats.
Service: Air circuits operating at 0-100 psi.

Circle 206 on Reader Service Card

Air Separator Filter

Jas. A. Murphy & Co., Inc.
Hamilton, Ohio

Service: For the removal of condensate liquid and any vapors present in compressed air.

Design: The unit consists of a separator "B" on which is mounted a transparent cylinder holding the desiccant.

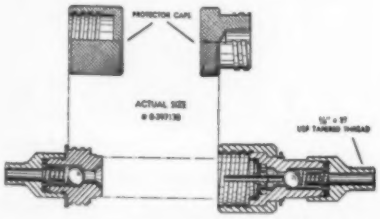
Operation: The liquids from the separator "B" are collected by the trap "A" which are automatically discharged into the atmosphere at the bottom. As the oil and water vapors travel from the separator "B" into the chamber containing the desiccant "C", the color of the desiccant changes to a deep amber, beginning at the bottom of the chamber "C" and when color reaches the top of the desiccant, it is time to renew the charge.

Circle 207 on Reader Service Card

Quick Disconnect Coupler

Lewis Kirschman Company, Inc.
New York, N. Y.

Service: High pressure coupling applications on industrial and aircraft hydraulic systems.

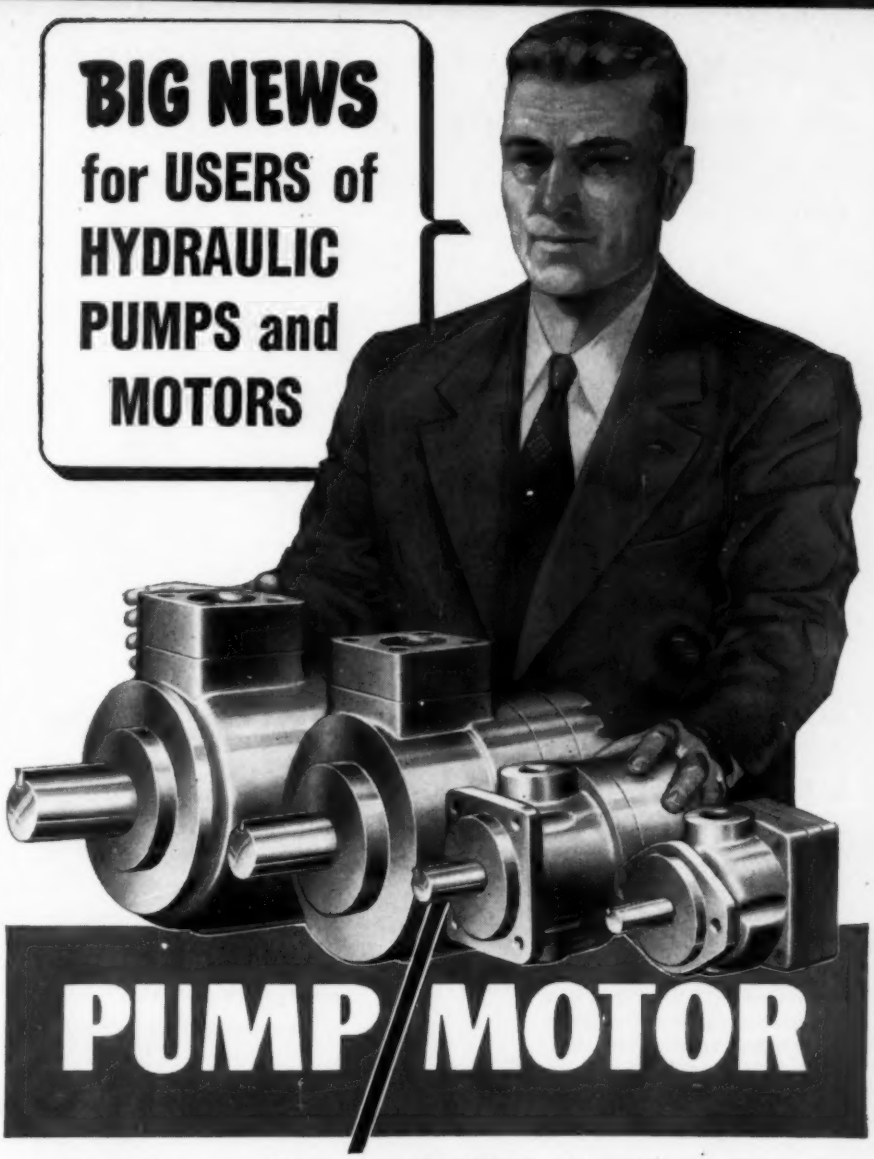


HIGH PRESSURE QUICK DISCONNECT COUPLER

Specifications: Designed for a working pressure 10,000 psi and tested at 20,000 psi, the coupler is a self sealing design made of alloy steel and has a flow area of ¼ in. The coupling ends are supplied with aluminum protector caps.

Circle 208 on Reader Service Card

BIG NEWS for USERS of HYDRAULIC PUMPS and MOTORS



PUMP/MOTOR

Dual-Purpose, Vane-Type POWER for Continuous Duty

Here's the kind of rugged, low-cost, long-service hydraulic power you've been wanting! Offering complete hydraulic balance of *both vanes and rotors,* this unit assures a dependable performance. Interchangeable cam rings — available for each of four sizes — provide eleven different models. Adaptable for either clockwise or counter-clockwise operation. Denison Pump/Motors are ready for use as either pumps or motors without alterations of any kind . . . built for hard, continuous duty at pressures up to 2000 psi. Pumping capacities range from 2½ to 70 gpm. Torque ratings for motor applications range from 13 to 257 inch-pounds per 100 psi. Wide variety of combinations possible for any porting requirement. Choice of mounting arrangements including CIMTC standards. Get full details on Denison Pump/Motors; write today for Bulletin P-5!

"The Finest Money Can Buy!"

The DENISON Engineering Co., 1166 Dublin Rd., Columbus 16, Ohio

DENISON Hydr OILics TRADE MARK

Circle 96 on Reader Service Card

Exactly to specification —you can depend on it!

Beginning with the selection and processing of raw hides and compounds . . . every step in the manufacture of Trostel packings and oil seals is laboratory planned and controlled to produce the exact combination of properties called for in the customer's specifications.

This unusually complete control is possible because Trostel performs *all* of the production operations in *both* leather and rubber—tanning, compounding, impregnating, molding, pilot testing—even the production tools are designed and built within the Trostel organization.

The result is a better packing or oil seal *specifically engineered and produced* for a definite operating requirement.

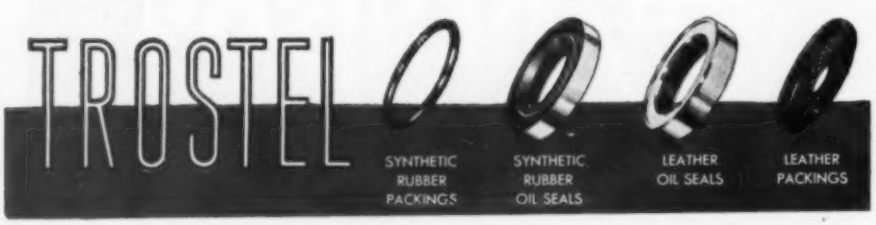
We invite your inquiry.

LABORATORY CONTROL

COMPLETE TOOLING FACILITIES

100% INSPECTION

ALBERT TROSTEL & SONS COMPANY
General Offices and Packings Division • Milwaukee 1, Wis.
Sales Offices: Houston • Los Angeles • Worcester, Mass. • San Francisco • Seattle



Circle 82 on Reader Service Card

Large Bore Cylinders

Columbiana Engineering Company
Columbiana, Ohio

Type: Special service heavy duty cylinders

Size: The custom built cylinder illustrated here has a 17½ in bore and is built for 250 psi oil service.

Application: This single acting cylinder is used in coil lift mechanisms of pay-off and tension reels for hot or cold strip mills.

Circle 209 on Reader Service Card

Oil Sight Gage

The Rucker Company
Oakland, California

Service: Reflex sight gage is adaptable to any equipment where it is desirable to observe the liquid level or the internal

activity of tanks or reservoirs. Unit will withstand temperatures to 500 degrees F and pressure to 15 psi.

Construction: The standard model is made with cast iron housing, fluted pyrex-type sight glass and asbestos gaskets. Standard visible length is 4½ inches, but the gage can be manufactured on special orders with visible lengths up to 12¾ inches.

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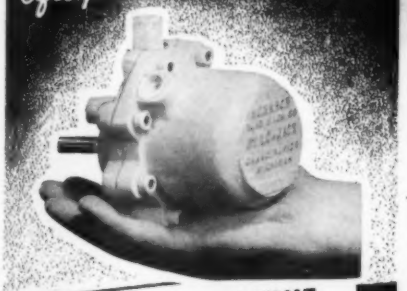

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- One gallon per minute volume.
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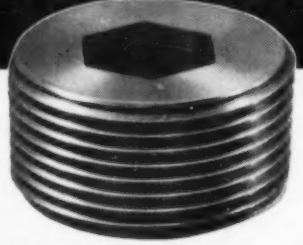

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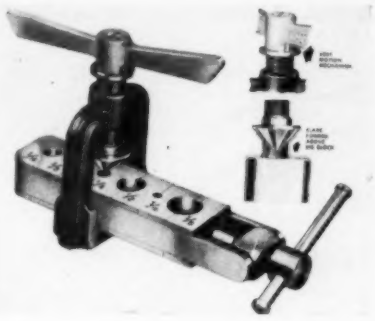
Tube Flaring Tool

The Imperial Brass Mfg. Co., Chicago, Illinois

Service: For flaring soft copper, steel, aluminum and brass tubing. The face of the flare is automatically burnished after it has been formed.



Operation: The burnishing action is provided through the use of a lost motion mechanism in the yoke which disengages the feed during the first revolution when backing off the cone. The flare is formed in the air above the flaring bar instead of against a bevel in the bar. This assures that the original wall thickness of the tubing is maintained at the base of the flare, and results in stronger flares which stand up better under vibration.

Designation: No. 500-G Rol-Air Flaring Tool

Sizes: The tool will make 45 degree flares on 3/16, ¼, 5/16, ⅜, ½ and ⅝ OD tubing for standard S.A.E. flared fitting joints.

Circle 211 on Reader Service Card

Governmatic Test Machine

Greer Hydraulics Inc., Brooklyn, New York

Designation: Governmatic Test Machine

Service: Used to test the latest double capacity, double acting, reversible pitch and fully feathering propeller governors.

Design: The new test machine has been redesigned by Greer in close cooperation with Hamilton Standard. The new unit has a 7½ hp drive and a pump which provides pressure to 1500 psi. The machine has an adjustment to simulate the sensitivity of the particular propeller governor under test.

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A-6 Committee Approves General Hydraulic System Specs

WHEN chairman B. R. Teree called the spring meeting of SAE Committee A-6, Aircraft Hydraulic and Pneumatic Equipment, to order at the Jung Hotel, New Orleans, on Wednesday morning, April 9, he greeted over 160 representatives of airframe manufacturers, equipment suppliers, the Servics and other technical agencies as well as the entire Committee membership and their guests.

Mr. Teree turned the gavel over to Fred O. Hosterman, Weston Hydraulics, Ltd., and chairman of Hydraulic System materials Subcommittee. As for several previous meetings, the major items discussed by this Subcommittee were nonflammable fluids and high temperature hydraulic requirements. This discussion lasted the better part of the first day.

At the specific request of Chairman Teree, a prelinminary meeting by the west coast aircraft hydraulic engineers was held at Douglas El Segundo Division on March 21, 1952. The main purpose of this meeting was to discuss the items on the agenda of the A-6 meeting and consolidate the views of the west coast engineers in order to save a great deal of time at this New Orleans meeting. Copies of the minutes of this preliminary meeting were distributed and recommendations read whenever necessary at the direction of the Chairman.

Nonflammable Fluids

Leo. M. Chattler, BuAer, reviewed the Navy experience with MIL-F-7083 (Aer), H2 fluid, stating that more than 2000 aircraft are now using the fluid and that a very good service record has been achieved.

Several airframe representatives presented their service experience in the performance of this fluid. Philip Musa, Grumman Aircraft, stated that some backup ring difficulties had been met. Tests had included the immersion of electrical equipment in H2. Ralph E. Middleton, Lockheed Aircraft Co., reported corrosion in hot areas and some trouble with slide valves sticking, due, he believed, to the conversion. He stated that the difficulties were probably due to a residue of old fluid and remarked that the sticking of valves had not been serious. When valves were started with H2, no trouble was experienced. He had found only slight trouble with leather backup rings but did report foaming under rapid landing and take-off conditions.

John Bloom, Douglas Aircraft, El Segundo, reported on the use of H2 in the AD series airplane. They had cracked high pressure manifold blocks; however, tests did not indicate the fluid was at fault. He reported three cases of burst reservoirs which he attributed to their marginal strength. He also reported galling of reservoir cap threads which was corrected by lithium sulfide paint. In regulators, teflon chevron type backup rings replaced leather. A good deal of trouble was experienced with diaphragm type accumulators. This trouble was corrected by change to piston type accumulators.

Dwight E. Leach, Chance Vought Aircraft, reported no corrosion on old planes but some evidences on new systems, due, he stated, to entrance air. Using large reservoirs, he had no foaming trouble.

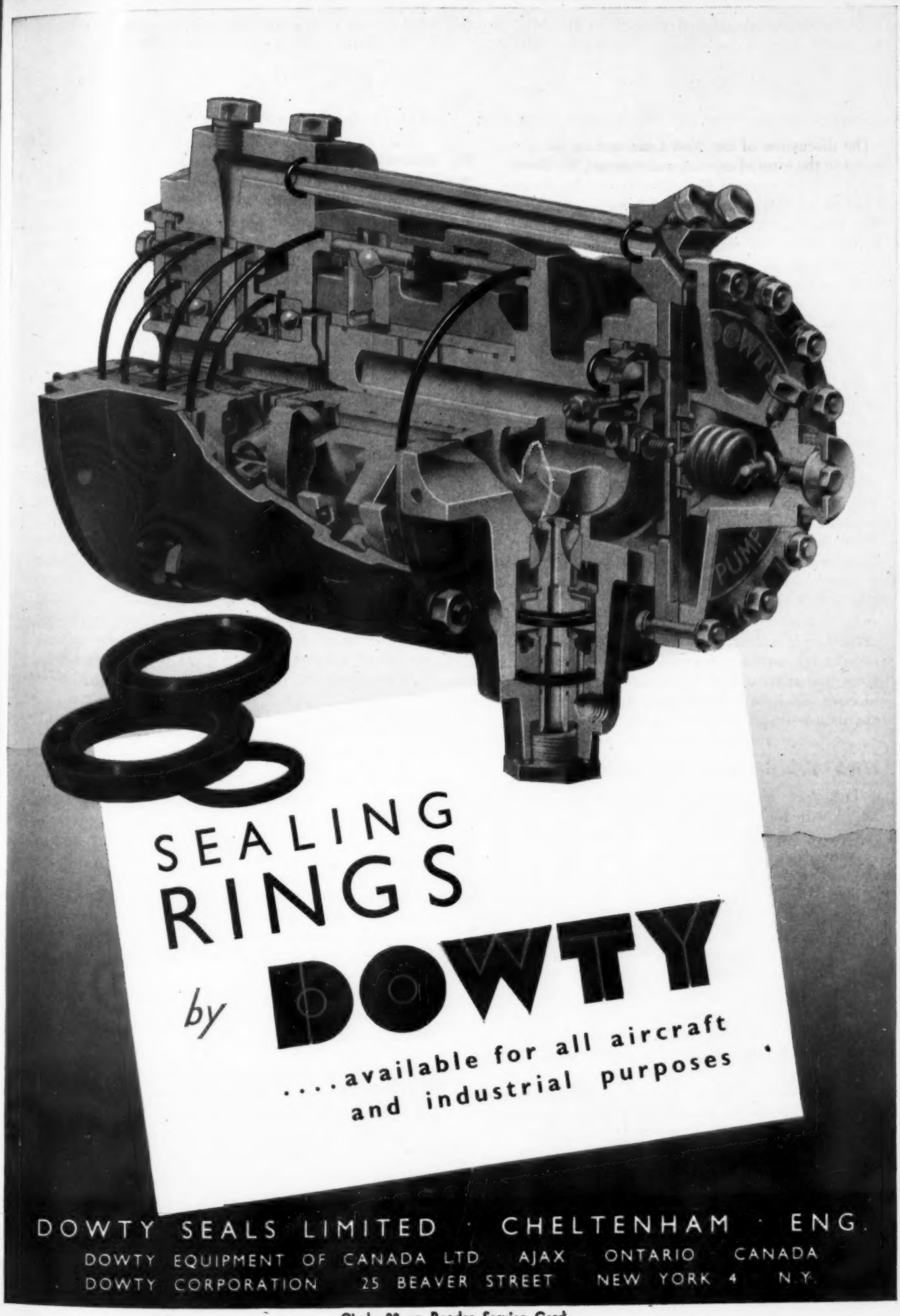
Frank Mittell, North American Aviation, reported very good results, as did Ralph Middleton, Lockheed Aircraft Co.

Leo Chattler stated that service kits for changing regulators had been supplied to Navy maintenance bases. The one reportable difficulty with H2 fluid was that the landing gear operation time was greater. He expressed the view that overall experience with H2 had been very satisfactory.

Harry M. St. John, Hamilton Standard, in reporting on a pump test with H2 stated that a pump that had run 560 hours had exhibited inlet port erosion (none with AN-O-366), due possibly to vapor pressure.

Karl Galligher, New York Air Brake Co., also reported erosion and agreed it may have been due to vapor pressure.

E. H. Schanzlin, Pesco Products, reported some corrosion of the drive shaft seal and that engine drive pads ran hot. Mr. Middleton reported some corrosion pitting in tubes (mostly 52 SO) and at focal points near flanges.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Discussion disclosed that a modified H2 fluid, designated B, now being qualified, probably will eliminate corrosion.

Temperature Rise in Hydraulic Systems

The discussion of the West Coast meeting was presented in the form of minutes and recapped. Mr. Bloom cited comparisons of stabilization temperatures reached by MIL-O-5606 mineral oil and MIL-F-7083. The latter ran 16 to 22 degrees F higher in AD airplanes, where the reservoir is cooled by forced air to a shroud; in another airplane where an oil to fuel heat exchanger was used, temperatures stabilized at up to 11 degrees F cooler with MIL-F-7083. In another system on the same plane, with long lengths of line and no special provision for cooling, H2 ran about 15 degrees F cooler.

Mr. Mittell reported on test experience with the new B fluid in a simulated system. He found no separation at stabilization temperatures of 190-195 F. Tests continued at increased increments of 5 degrees F up to 240 F with 10 psi reservoir pressure and to 255 F with 18 psi reservoir pressure. At 260 F bubbling and some cavitation resulted. A brown scum, the beginning of separation, was detected.

On the affect of MIL-F-7083 fluid on leather, Mr. Chattler cited base experience that leather backup rings removed looked in good condition, with only occasionally a bad ring.

J. N. Smith, E. F. Houghton & Co., reviewed the properties of leather, pointing out that neither waxes or resins were satisfactory impregnants for high temperature and that rubber was satisfactory to 240 F, not higher. Chairman Hosterman requested BuAer to continue testing.

High Temperature Hydraulic Systems

Jack Prete reported that AMC now has funds to go ahead with high temperature testing. Airframe representatives expressed the view that high temperature systems are on the drafting boards or farther and that the test program would lag behind, perhaps seriously.

Mr. Murphy reported that his tests have found leather backup rings with MIL-O-5606 fluid satisfactory ot 225 F, continuous temperature and to 300 F for limited periods. Leather backup rings in MIL-F-7083 were found unsatisfactory at 200 F. He pointed out that hydraulic system temperatures are running higher than 160 F (present limitation), sometimes to 200 F, with such peak loads as brakes to 250 F for short periods, and suggested a higher limit, perhaps 200 F.

Discussion was quite divided and no agreement could be reached on the most desirable temperature.

E. R. Bartholomew, AMC, reviewed the Air Force development on packing, polymers and fluids.

Jack Prete reported on one series of tests on packing and fluids, in which 5000 cycles in a mockup were run and the work cycle of 2 minutes permitting each unit to function normally. A total of 3600 cycles were run at room temperature; 1500 cycles at 150 F and 1250 cycles at —65 F. A silicate fluid was used. Operation was satisfactory at room temperature but difficulties were encountered at —65 F. At the request of the Chairman, Mr. Prete is to report final results at the next meeting.

MIL-P-5516 Packagings and Gaskets

The "O" ring spiral failure problem came up again. Mr. Middleton, quoting from his test experience, stated that he got spiral failures in a normal cylinder under normal clearances at temperatures of about 125 F. Mr. Bloom and Mr. Middleton agreed that Delta rings have eliminated spiral failure in all tests and service installations made to date. Mr. Bloom, quoting the West Coast minutes, recommended nonstandard packings when spiral failure is a problem. The most critical spiral failures have consistently occured in shock struts.

Mr. Prete said that their tests indicate that deeper grooves, leaving less squeeze, have improved performance.

Special Low Friction Seals

Mr. Bloom stated that the West Coast meeting agreed that "O" ring friction was too high for boost cylinders. He described a single 70 Shore hard rubber chevron with the same dimensions at the standard 90 Shore chevron, spring retained, and backed up by a teflon chevron had only one-third to one-half the friction of an adverse tolerance squeeze "O" ring. Mr. Hosterman reported tests comparing this chevron with a reduced squeeze "O" ring. Both had about the same running friction at a speed of one inch per second, the chevron had less break-out friction.

MIL-P-5514 Packings, Installation and Gland Design

Mr. Bloom pointed out that MIL-P-5514 limits the clearance of unbacked static "O" rings at 3000 psi pressure to .001 inch on diameter, including pressure expansion breathing. He reported tests showing that unbacked "O" rings withstand over 200,000 impulses —0 to 3000 psi with 4500 psi surges—at .0025 inch diametric clearance and complete eccentricity. By contrast, "O" rings at .003 inch clearance were good for only 4000 impulses. M. Hosterman reported a similar satisfactory test at .0025 inch clearance for 20,000 impulses.

The A-6 approved the West Coast recommendation that MIL-F-5514 be changed to permit .0025 clearance for unbacked static "O" rings.

Reliability vs Emergency on Duplicate Hydraulic Systems

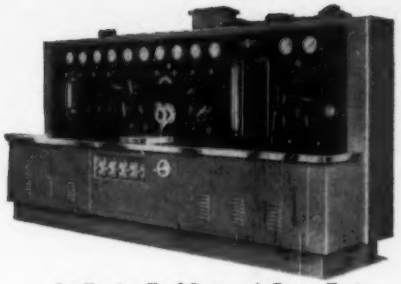
Mr. Chattler suggested the possibility that requirements for emergency or duplicate hydraulic systems on aircraft be lowered as the reliability of primary systems and components improve. He asked that serious thought, particularly by major airframe manufacturers, be given this subject.

Chairman Teree thanked Mr. Chattler for the suggestion and further urged that this problem be given continuous attention.

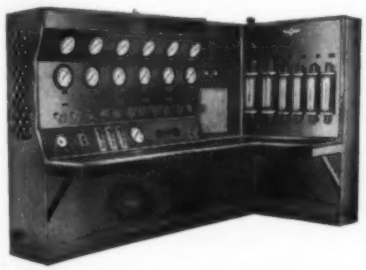
Hydraulic Accessories Test Machine

American-Bosch Nozzle Tester

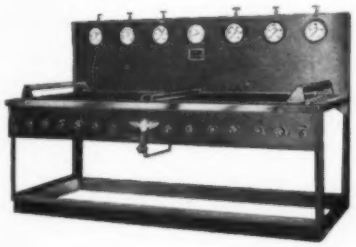
Oil Cooler Test Stand



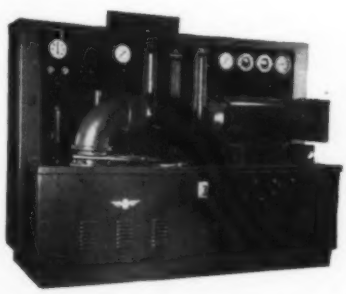
Jet Engine Fuel System & Pump Tester



Aircraft Leakage Test Stand



Boston Woven Hose Tester



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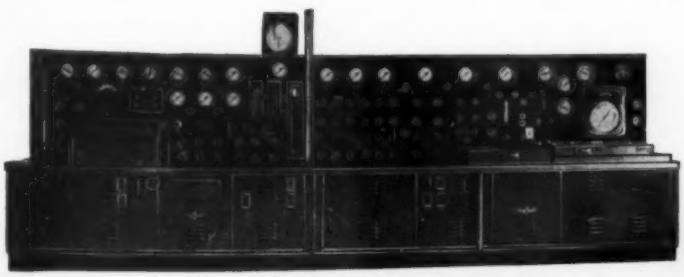
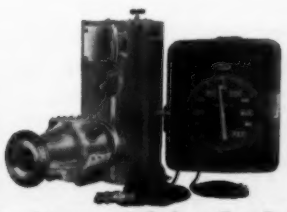
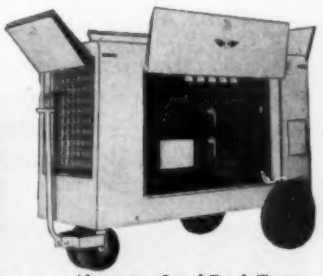


Laboratory-Type Test Machine



Speed Increaser & Reducer Gear Box



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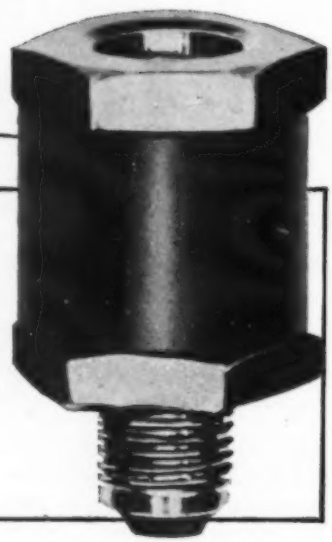

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Circle 92 on Reader Service Card

MIL-F-5504 Hydraulic Filters

Mr. Kidd summarized the results of a survey on the micronic, full flow inside-out filters, which the airframe manufacturers prefer to the outside-in type. Jules P. Kovacs, Purolator Products Corp., stated that a simpler, less expensive manufacturing procedure had been developed to produce this item. The chairman asked Mr. Kidd to prepare the AN drawing.

MIL-V-5523 Relief Valve, Hydraulic Pressure

Mr. Middleton distributed minutes of the special Subcommittee on Relief Valves held during February at Douglas, El Segundo. A number of changes recommended included hand pump cracking pressures, rated flows, reverse flow characteristics and scope of inspection tests. After long discussion, the changes were referred back to the subcommittee, the chairman directing that the new revision be sent to relief valve manufacturers and to the airframe companies.

MIL-V-5526 Hydraulic Restrictor Valves

Bob Green, AMC, reported their tests are incomplete. The low temperature work is expected to be completed in two months.

MIL-A-5498 Aircraft Hydraulic Pressure Accumulators

Mr. Stickney reported that AIA comments had been received and the data passed on to BuAer. The West Coast meeting agreed there was a danger of a diesel-action explosion if the accumulator is charged with air and suggested BuAer check test. Mr. Sigismund, BuAer, is to continue tests.

MIL-P-5518 Pneumatic Systems, Design, Installation and Tests

Al H. Hobelmann, chairman of Pneumatic Subcommittee of A-6, reported on progress being made on the general pneumatic system component specification and on the reservoir, relief valve and pressure reducing valve specifications. A separate meeting is planned in June for this subcommittee so that detailed reports may be given at the next A-6 meeting. The general industrial opinion was that the general pneumatic specification wait until the revisions to MIL-H-5440, the general hydraulic specification be worked out; the reservoir specification will be ready by July 1 for airframe coordination; the relief valve spec has equipment manufacturers comments and is ready for airframe distribution; the pressure reducing valve spec is being distributed to equipment manufacturers for comments.

Dr. Slawsky, National Bureau of Standards, reported briefly on component tests being made on BuAer contract.

Tubing and Fittings

Maj. Regnier reported that the fatigue life tests of various types of tubing at Douglas, Santa Monica, were only one-fifth completed but promised a report at the next meeting. Mr. Murphy described a fatigue testing machine setup they are using. The chairman asked the Air Force to distribute this information to the industry. Mr. Jacobs stated that no titanium tubing or fittings had been received for testing. Mr. Henderson reported drawings were complete on standardization of cluster fittings and that Douglas, El Segundo, was checking. The chairman asked Mr. Henderson for a report at the next meeting.

AN 6293 Four Way Selector Valve

J. W. Kelly, Adel Division, General Metals, stated that they had experienced some breakage on the AN 6293 shaft end and asked for consideration of ways to strengthen it. The chairman asked that Mr. Kelly's data and similar experiences be forwarded to the valve manufacturers and to members of the committee.

Hydraulic Components, General Specification

This specification is now being coordinated by the Services. Some BuAer amendments on test criteria remain for coordination. The chairman asked for a joint Service report after coordination is complete.

Mr. Kidd and Mr. Henderson reported briefly on the results of Subcommittees A-1 and A-3. These meetings are reported elsewhere in this issue.

MIL-H-5440 Hydraulic Systems

The third day of the meeting was reserved for a detailed discussion of this specification. Two detailed surveys, one of comments by airframe manufacturers of the proposed revisions of MIL-H-5440 (AN-H-2) which had already been coordinated by the Services, the other a summary of comments received by Mr. Pollard from a survey conducted through NASC nad Committee A-6, were used as the basis of the discussion.

Mr. Pollard read each comment, the detailed revisions suggested were discussed and voted on in turn. Mr. Chattler for BuAer and Mr. Green for AMC kept running record of changes agreed upon. Since every one concerned had already made written comments, agreement was reached on practically all points; those still not agreed upon will be reviewed by the Services and coordinated so that the specification can be forwarded quickly to ASG.

The Chairman thanked all aircraft manufacturer hydraulic specialists, the military service representatives, SAE Committee A-6 members and others present for their cooperation in disposing of this very important specification at this meeting.

The Chairman announced that the next meeting of SAE Committee A-6 will be held at the Hollywood Roosevelt Hotel, Hollywood, California on October 8, 9 and 10.

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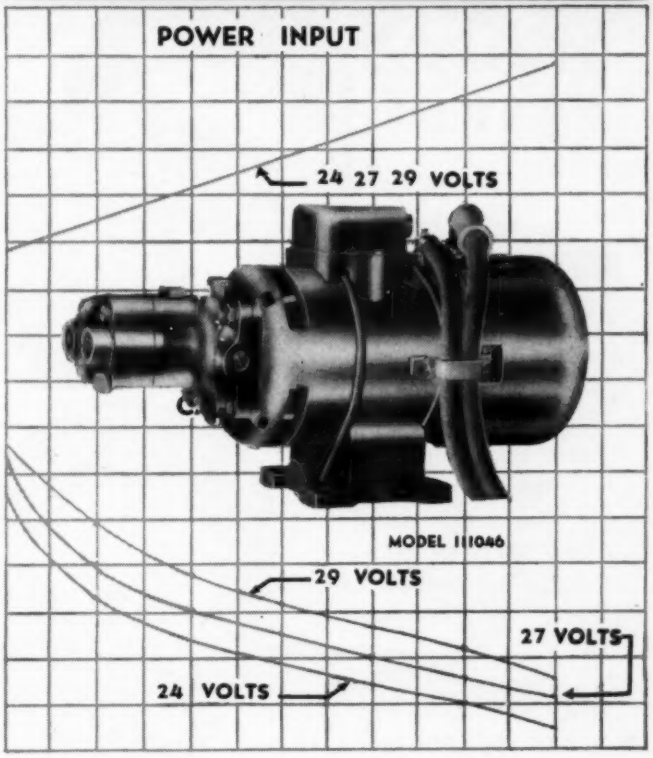
performance charts FIRST



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- High pressure—3000 p.s.i.
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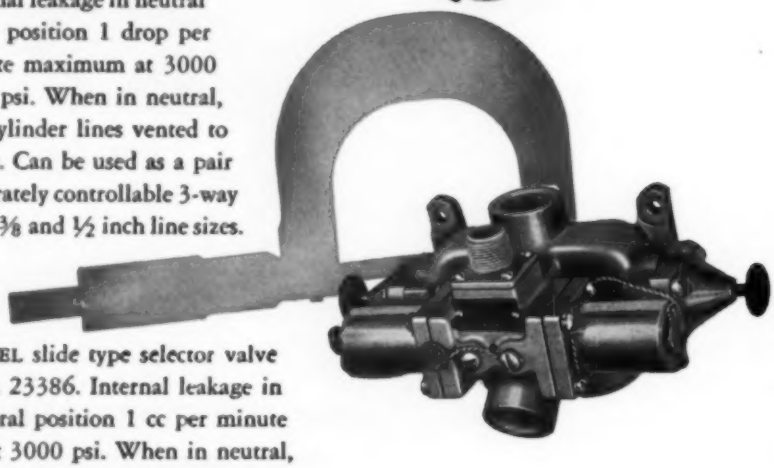
3000 PSI SOLENOID, PILOT-OPERATED 4-WAY SELECTOR VALVES

New ADEL poppet type selector valve No. 21700. Internal leakage in neutral position 1 drop per minute maximum at 3000 psi. When in neutral, cylinder lines vented to return. Can be used as a pair of separately controllable 3-way valves. ⅜ and ½ inch line sizes.



New ADEL slide type selector valve No. 23386. Internal leakage in neutral position 1 cc per minute at 3000 psi. When in neutral, cylinder lines can be blocked or vented to return. Variations available with centering springs or detents. ¼, ⅜ and ½ inch line sizes.

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Circle 2 on Reader Service Card

Aircraft Pump Report

THE SAE Committee A-1, Aircraft Pumps, held their regular semi-annual meeting on Tuesday, April 8, at the Jung Hotel, New Orleans, La. When chairman J. Milton Kidd, Glenn L. Martin Co., called the meeting to order over sixty representatives of airframe manufacturers, the Services, pump manufacturers and representatives of National Aircraft Standards Committee and AETC Pump Subcommittee were on hand.

High Speed Variable Delivery Pump Specification

William R. Beckerle, SAE secretary to the A-1 Committee, reported that the High Speed Variable Delivery Pump Specification and the Table of Recommended Port Sizes for Hydraulic Pumps was in the hands of ASG (Aeronautical Standards Group).

Electric Motor Driven Hydraulic Pumps

Kenneth I. Postel, Vickers, Inc., reported on the coordination work being done for Committee A-1 with the Electrical Subcommittee A-2M regarding the use of standard electric motors to drive hydraulic pumps. R. P. Loveland, General Electric Co. and chairman of A-2M, again present by invitation, pointed out that the number of combinations of motors and pumps his company alone has supplied has passed 70. He stated that practically every motor-pump combination was different and that this situation seriously hampered deliveries.

Mr. Postel reminded the meeting that this work has been going on for four or five years and that spline, pad, speed and flange differences still exist. He agreed with Mr. Loveland that the major immediate problem was to bring the motor and the pump takeoffs together. Considerable discussion developed, especially around female spline drives, differences in sizes, ratings and usages of pumps.

Chairman Kidd appointed a subcommittee with Mr. Postel as chairman and with the following members: M. W. Huber and Karl W. Galliger of New York AirBrake Co.; Harry W. St. John of Hamil-

ton Standard and E. H. Schanzlin of Pesco Products to assemble and report on pump data.

General Specification for Standard AN Pumps

Lt. Bracke, Air Material Command, in the absence of Joe Mileti, reviewed the progress made and suggested that the engine manufacturers provide space for AN pumps. However, most pump representatives present were of the opinion that this was not possible due to the difficulties in changing engine design. There was agreement that a composite envelope, with the minimum of peripheral projections so that the pumps could be rotated for fitting, provided the best solution. The chairman appointed Karl Galligher and M. Caserta to prepare such composite envelopes, Mr. Galligher to prepare the pump envelope, Mr. Caserta the compressor envelope.

Fuel Pumps

At the request of J. F. Murray, Thompson Products, Inc., the fuel testing section of MIL-E-5009A, Qualification Tests for Turbojet Engines, was discussed. Mr. Murray asked for a deviation on the altitude testing portion of the specification and the adoption of the vapor-liquid ratio as a measure of performance. John Marshall, Bendix Products Div. of Bendix Aviation Corp. and chairman of the AETC panel on vapor-liquid ratio investigations, reported on the results of his panel's work. Discussion developed that there were still problems in measurement and control of vapor-liquid ratios in fuel pump testing, in pulsations at various pressure-speed conditions and in the effect of pulsations on engine fuel systems.

Air Compressors

Michael Caserta of M C Mfg. Co. reported on his meeting with AMC, called in an effort to resolve the industry's comments regarding General Specification MIL-C-6591, Air Compressors. Mr. Caserta also had comments which he had received from members of the Pneumatic Subcommittee of A-6, of which he is a member. More coordination work remains to be done on this item.

Variable Delivery Pump Pulsation Test

Carl Sadler, Sundstrand Machine Tool Co., reported on the status of the Variable Delivery Pump Pulsation Test and proposed one change, a separate throttling valve. Several clarifying revisions, circulated to the industry, were reviewed.

Mr. Kidd reported on tests conducted at Martin with a New York Airbrake 9.4 gpm pump and a 3⅜ in. bore, 21 in. stroke and 1¾ in. rod cylinder (volume 141.5 cu in). A maximum surge pressure of 3750 psi, duration of .04 sec, was developed with the pump operating at 2700 rpm. This was within the specification of 4000 psi transient pressure. A smaller cylinder (about 80 cu in) developed a surge pressure of 4000 psi.

The discussion developed that more leakage was desirable. Carl Sadler suggested 50 cc per minute. This was generally agreed upon as well as a cylinder of 4 in. bore and a volume in the range of 130-140 cu in for the final drawing. Carl Sadler is to make the final changes and send the specification to ASG and AIA.

Hydraulic Pump Couplings

Dwight E. Leach, Chance Vought Aircraft, reporting on laboratory tests only, stated that they had experienced no failures. He and several other airframe representatives reported continued coupling failures in service. Mr. Leach suggested that heavier couplings might solve the problem. Karl Galligher expressed the opinion that the very heavy fatigue rate was probably due to the rapid cutoff of pumps.

Pump Flanges

The discrepancies which still exist between actual pumps, General Pump Specifications and applicable AND 10260 series Flange and Spline Drawing requirements were discussed. E. G. Emery, Jr., Pratt & Whitney Aircraft reminded the Committee that Specifications AND 10260, 10261, 10262 and 10263 were issued as applicable flange standards, endorsed by the accessory manufacturers, through AIA for use on air, hydraulic, fuel pumps and similar fuel control components. Existing pumps do not agree with the drawings.

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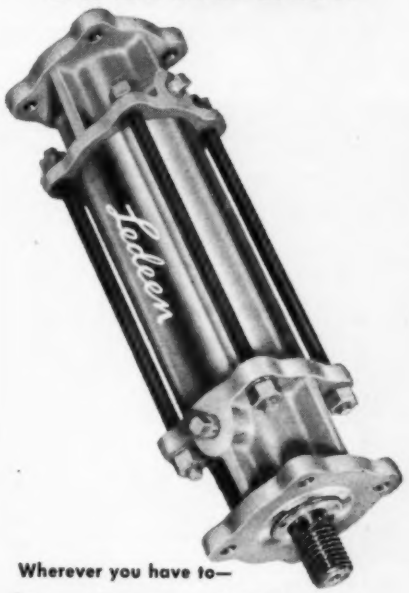

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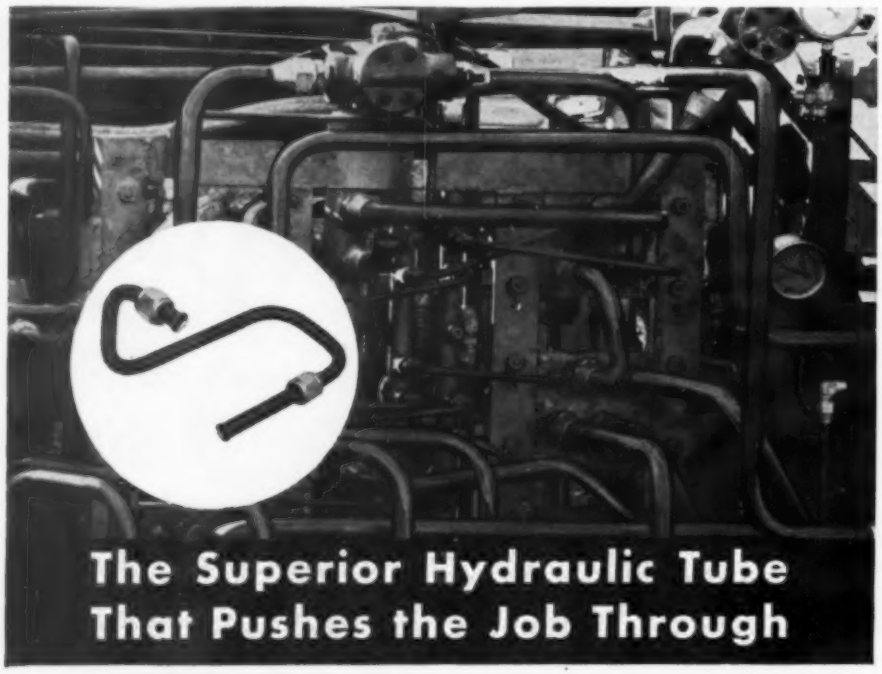
Aviation Report:

Fittings and Hose Assemblies

SAE A-3 Committee, Aircraft Flexible Hose Assemblies and Fittings, held its regular spring meeting on Monday, April 7 at the Jung Hotel, New Orleans, La. Les J. Henderson of The Weatherhead Co., chairman, presided over the very full agenda which was completed in one day. A total of 15 items were on the agenda, eleven of which were carried over from the previous meeting.

AN 937, AN 938, AN 939 and AN 941

R. W. Phillips, The Weatherhead Co., reported on additional tests made on size -20 fittings. He reported the same type of failure occurred as in previous tests and that the fitting die was being reworked to provide greater wall thickness. It is expected that new tests can be run in 60 days. F. F. Jacobs, BuAer, requested that testing on these new fittings be completed as soon as possible. A question was raised as to the possible use of a steel fitting to eliminate the problem. The concensus of opinion was insufficient data was available to determine this.



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AN 775 Bolt

Ralph E. Middleton, Lockheed Aircraft Corp., distributed copies of a report that indicated that this fitting, now in use by North American, overcame the disadvantages of the standard fitting. He recommended that the fitting used by North American replace the present AN standard bolt. Chairman Henderson asked Mr. Middleton to conduct a survey through NASC (National Aircraft Standards Committee) to determine if airframe manufacturers would accept the North American fitting.

Nut for Locating Fitting

Major R. Regnier, Wright-Patterson Air Force Base, reported that development contracts to develop the new type nut would be let during April. It is expected that data will be available for presentation at the next meeting.

Marking of AN Tube Fittings

Lee H. Schmohl, The Parker Appliance Co., reported on a survey to determine the most desirable method for marking fittings. The report included discussions with the Services at a two day meeting in March. The decision reached was that impression stamping, ink stamping and thread protectors (preference in order given) will be listed in MIL-F-5509 as acceptable methods of placing part numbers on AN or MS fluid fittings. R. Y. Irwin, Northrup Aircraft, Inc. stated that his company is considering the individual packaging of AN fittings. It was brought out in the discussion that fittings could be packaged individually in cellophane bags at a cost not considerably higher than the

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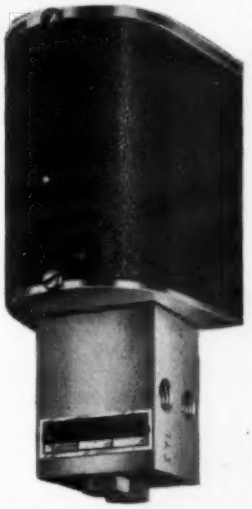

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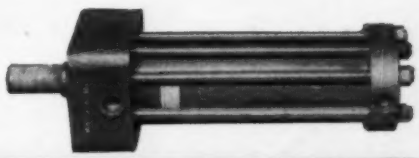

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3/8" Tube Size – 9/16 x 18 Thread – 20" long with Female fitting at both ends. . . . . $1.90 each
Same as above but 63" long. . . . . $3.75 each
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Accumulators are used for constant pressure, both in line and reserve storage for instant use to take the lag from the pump.

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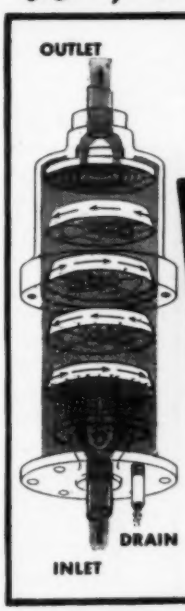

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For paint and lacquer spraying, ceramic, sand blasting, air cleaning, etc. Easily replaces less efficient baffle type devices. Tell us details of your problem when you write for a catalog.

CAPACITY RANGE: AS LOW AS 7 CFM TO 17,000 CFM.

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present cost if thread protectors were omitted. Fittings so considered would only include those through which fluid flows.

Chairman Henderson requested Mr. Irwin to survey NASC to determine the acceptability by the aircraft manufacturers of individual packing of AN standard fittings. The survey is also to determine if thread protectors could be omitted if cellophane packaging is accepted. F. E. Emery, Jr. was requested to advise the engine manufacturers of this program and to collect comments. Major Regnier and Leo Chattler will check with their supply divisions regarding both marking and packaging recommendations of the Committee.

Unified Threads

F. E. Jacobs, BuAer, reported on the survey conducted to determine the class of thread to be used on AN fittings. The fitting manufacturers present agreed that the 2A, 2B unified thread combination should be used on AN fittings. Mr. Schmohl was requested to forward data on what the "C" dimension would have to be to remove the thread chaser marks when the Class 2A, 2B thread combination is used. The recommendation of the fitting manufacturers will be forwarded to ASG.

AND 10064

Frank C. Mittell, North American Aviation, reported on a survey he is conducting through the aircraft industry to determine the desired installation instructions to be placed on AND 10064. Chairman Henderson requested Mr. Mittell to report further on this survey at the next meeting of the Committee.

AN 901 Gasket

R. Y. Irwin, Northrup Aircraft, Inc., outlined the troubles he has been having in attempting to anneal gaskets properly; he requested that, in the interests of more consistent results, that a hardness be specified on the drawing.

This point developed considerable discussion and the chairman requested Mr. Irwin to survey the air frame manufacturers to determine what hardness should be specified on the drawing. F. E. Emery, Jr., Pratt & Whitney Aircraft, was requested to advise Mr. Irwin as to whether or not a hardness was specified on the six digit standard for a similar gasket recently proposed by the engine companies, and, if it was, the hardness called for.

AN 6290 "O" Ring

John Bloom read Douglas, El Segundo's Test Memorandum Report proposing a new "O" ring for use in fuel systems. He furnished new data on the size of the new "O" ring for use in fuel systems. This report has been forwarded to members of ETCD, a subcommittee of ETC Committee, which is already working on the fuel system "O" ring problem. Discussion developed that Committee AE-1 is also considering the problem of fuel system "O" rings.

Mr. Carl Sadler, Sundstrand Machine Tool Co., advised that Committee AE-1 will hold a meeting in September, at which time the whole "O" ring problem will be coordinated. Mr. Sadler invited members of A-3 Committee to attend.

Chairman Henderson reviewed A-3 Committee's recommendations and stated that, while all manufac-

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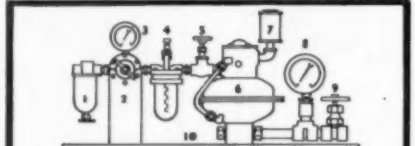

NO.	DESCRIPTION
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7	Air Muffler
6	Sprague S-216C Pump
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3	Air Gauge
2	Air Regulator
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turers produce many special fittings, another line of fittings would not help them minimize service and supply problems. It is believed that with suitable changes in "O" rings, standard AND 10049 and AND 10050 bosses and standard fittings can be retained for use in both fuel and hydraulic systems.

Chairman Henderson thanked his committee and their industry and Service guests for their efforts in completing a heavy schedule in one day. The very large attendance was evidence of widespread interest and acknowledgement of the value of the Committee's work. The next meeting of the Committee A-3 will be the same week at the A-6 Committee as reported elsewhere in this issue.

AN Fittings

Chairman Henderson briefly reviewed the items covered in the recent meeting of fitting manufacturers and the Services on AN Standard Fittings. He reported that a subcommittee has been appointed to review all fitting drawings and bring them up to date. It is expected that this work will be completed by the time of the next meeting.

Major Reginer, AMC, distributed copies of the minutes of the meeting; it was requested that any comments on the minutes should be forwarded to Chairman Henderson by June 1st. Mr. Irwin exhibited a sample of an AN 776 fitting which, due to incomplete information on the drawing, allowed the fitting manufacturer to furnish a part which was unacceptable considering weight and space requirement, although it met the requirements called for on the standard drawing. Chairman Henderson commented that such items will be cleared up in the present review.

The question was raised as to whether or not all AN fittings with pipe threads would be made obsolete. Mr. Stickney advised that, due to the fact that services outside the Air Force and BuAer used fittings of this type, no overall action can be taken at present.

MIL-C-5501 Closures

Frank W. Murphy, Douglas Aircraft Co., Inc., Santa Monica, reported on the results of a survey made to determine pressures closures are expected to withstand. In view of the contradictory nature of the replies, it was not possible to arrive at a definite conclusion. Chairman Henderson determined that the decisioin would be left up to the Services and asked Bob Green, AMC, and Leo Chattler, BuAer, to take this matter up with their supply divisions and to report back at the next meeting.

MIL-H-5511, Hose Aircraft

Mr. Phillips reported that he had run over 50 tests since the installation of the Selas furnace. He was reporting as chairman of a subcommittee on fire tests. The test indicated that the furnace gave consistent results, not possible previously with a torch or other means. The concensus of opinion was that the fire test section of the specification should be revised.

Chairman Henderson requested Mr. Phillips to have his subcomittee

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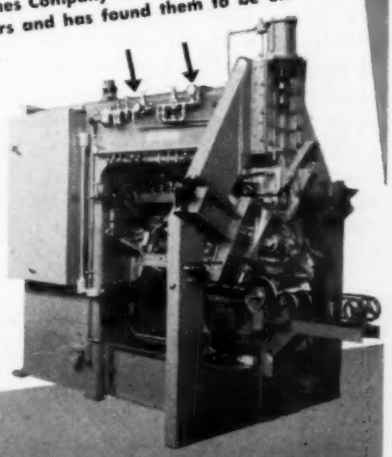
PROBLEM:
To find standard lubricating, air pressure regulating, and air line filtering equipment which would be readily available in sizes and types for easy make up into various assemblies for a wide range of specially designed production-line resistance welders.

SOLUTION:
Use of Norgren Lubricators, Regulators, and Filters.

RESULTS:
"National Electric Welding Machines Company has standardized on Norgren air accessories for years and has found them to be extremely satisfactory.

This special 200 KVA Seam Welder automatically roll-forms, sizes, feeds and mash-seam-welds metal containers from 15" to 25" dia. and 10" to 30" long. This is a typical National Electric Welding Machine Company product, using Norgren lubricators, air line filters and air pressure regulators. Primary air pressure ranges from 80 to 100 psi; secondary from 60 to 80 psi.



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revise the appropriate sections of the specification. It was also requested that appropriate vibration requirements be included. Mr. Phillips will report progress on this project at the next meeting. John Bloom, Douglas Aircraft Co. Inc., El Segundo, reported unsatisfactory results with –4 size hose assemblies using MIL-H-5511 hose. Information developed by discussion indicated that quantities of MIL-H-5512 hose in this size would be available by June, 1952. It is believed that this will eliminate such difficulties described by Mr. Bloom.

MIL-H-5512 Hose Assemblies

Willard Haas, The B. F. Goodrich Co., explained in detail the manufacturing problems encountered in the manufacture of –8 and larger sizes of MIL-H-5512 hose. Due to these troubles a shortage of the super-hose exists at present. Jack Prete, AMC, stated that, in order to maintain production, deviations from the 100,000 cycle requirements are being granted on the following basis:

SIZE	PRESSURE PEAK	CYCLES
-8	4500 psi	60,000
-10	4500 psi	40,000
-12	4500 psi	30,000
-16	3750 psi	50,000

The hose will be identified by the hose couplers, with suppliers listed on QPL 5512 by identification numbers. Mr. Prete suggested that a record of the serial numbers of the airplanes in which deviated hose assemblies are used be kept to assist in evaluating the performance of the hose at a latter date.

Mr. Jacobs stated that BuAer would grant the same deviations. Mr. Prete, in answering a question as to what was being done to develop a better hose for high pressure, stated that several development contracts had been placed to develop both synthetic and flexible metal hose.

The question was asked if air frame manufacturers could do their own coupling under this specification. Both Mr. Prete for AMC and Mr. Chattler for BuAer agreed that they could provided they followed the quality control procedure required of the hose couplers. Mr. Leach mentioned that he is assembling high pressure hose assemblies at Chance Vought.

AN 6290 "O" Ring

J. H. Swartz, Linear, Inc., reported that tests were not complete and, at the chairman's request, he will report further at the next meeting.

Bleed Valve

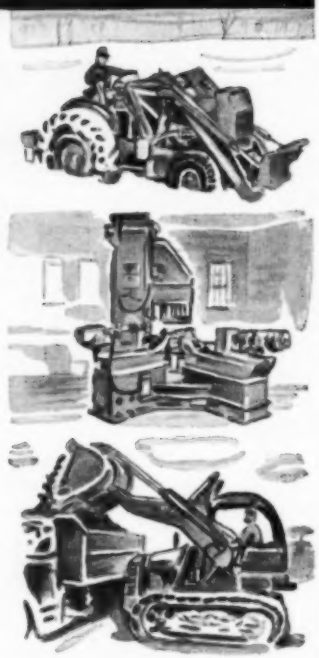
Mr. Schmohl reported on the results of a survey for an envelope drawing on this valve. The chairman requested Mr. Schmohl to turn the envelope drawing over to Committee A-6 for further review.

AN and MIL Specifications

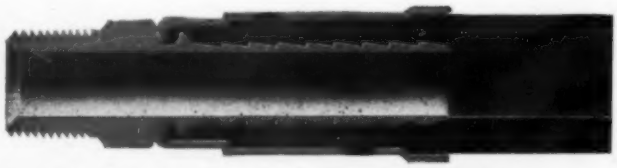
R. N. Stickney, ASG, reported that all changes and recommendations of Committee A-3 are in the process of being incorporated in the latest revisions of the following drawings and specifications: AND 10050, AND 10056, AND 10057, Drawings for Flange Hose Ends MIL-H-5509, MIL-H-5593, and AN 901 Gasket.

MULCONROY *Hydraulic*
HOSE ASSEMBLIES

With Triple-Grip
"PRESS-LOCK"
Couplings



With "Press-Lock" Couplings attached, Mulconroy Hose Assemblies provide a new measure of safety, efficiency and economy for all operating or control lines on every type of hydraulic equipment. They are available in three basic hose constructions, to meet any required working pressure; in a full range of sizes and in lengths up to 50 feet. Quickly and easily installed by attaching standard male threaded end of each "Press-Lock" Coupling.



Cut-away view showing unique construction of "Press-Lock" Coupling. Note that entire hose wall is employed.

Three-way gripping efficiency is provided by the "Press-Lock" Coupling, as follows: Inner section of hose wall is pressed into corrugations on stem; outer hose wall, with reinforcing wire, is displaced under pressure into openings in coupling sleeve; sleeve is anchored to collar on stem, back of hex portion.

Because the entire hose structure is employed in attaching the "Press-Lock"— no part cut away—hose will withstand shock loads and continuous flexing far beyond the limits attainable by use of conventional type couplings for this service.

Write for Illustrated Catalog

"MULCONROY *Starts...* WHERE OTHERS *Stop!*"

MULCONROY CO. *Hose Specialties Since 1887*
5329 JEFFERSON ST., PHILADELPHIA 31, PA.

Circle 49 on Reader Service Card

Powerful Test Machine Used for Aircraft Parts

A "TORTURE" machine with a 500,000 pound squeeze and used to test the strength of airplane parts, has been put into operation in a Lockheed Aircraft Corporation laboratory at Burbank, Calif. The new device, a stretcher-compressor, is the largest and most bruising device of its kind ever developed in the aircraft industry, according to H. W. Foster, dynamics research engineer, who designed and supervised the construction of the apparatus.

Functionally a fatigue tester, the new machine is designed to handle such high-strength parts as the damper piston of a Super Constellation landing gear and sections of the transport's wing structures. The piston, shown mounted in the machine, is made of high-heat-treat steel capable of withstanding greater loads than any steels previously made.

Fig. 1. LOCKHEED RESEARCH engineers H. W. Foster, right, and Jack Ryan, left, inspect a transport landing gear piston (at Foster's hand), ready for fatigue test in the new 500,000 pounds force machine. Pressures exerted by a hydraulic jack (floor level) and a rotating unbalanced weight set up vibrations in the steel masses, left and right.

In principle, the test machine differs little from other Lockheed inertia-loaded fatigue-testing machines of smaller capacity, except that it employs a moving instead of static reaction in order to avoid driving its full force into its foundation.

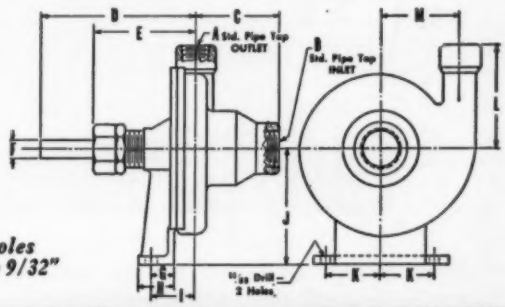
The pressure applying apparatus is suspended from the girder framework; two heavy beam assemblies are suspended by flexible mountings from both ends of the overhanging frame. An electric powered rotating, unbalanced weight in one beam assembly and a horizontal hydraulic jack tieing the beam assemblies together at their lower ends provide the testing forces.

The part to be tested is clamped between the beams; connecting rods, in lengths to fit the test part, hold the part in place. A preliminary force is applied by the

Centrifugal pumps must be primed or located below the level of the liquid to be pumped so that they will be gravity fed.

These pumps may be driven with a V belt pulley or directly connected to an electric motor by a flexible coupling. They are used for pumping fuel oil, gasoline, water, coolants, brines and many other liquids. The open impeller design permits the handling of a percentage of semi solids.

The 4G and 9G may be operated with a ¼ horsepower motor. The efficiency of a centrifugal design is increased greatly by increasing the r.p.m. of the shaft. The 1G requires but a ½ horsepower motor when operating at 3450 r.p.m.



*Foot holes in base 9/32"

DIMENSION TABLE

No.	A	B	C	D	E	F	G	H	I	J	K	L	M
1G*	⅛	¼	2 7/32	3 5/16	2 3/32	5/16	5/16	⅝	7/64	1 13/16	1⅝	2 3/32	1⅛
4G	½	¾	2 9/16	4 7/16	2 11/16	½	½	1	1¼	3¼	1½	3	2 3/32
9G	1	1¼	2 13/16	5 9/16	3 5/16	½	1 1/16	1 5/16	1¼	3¼	1½	3⅝	3 3/32

CAPACITY TABLES

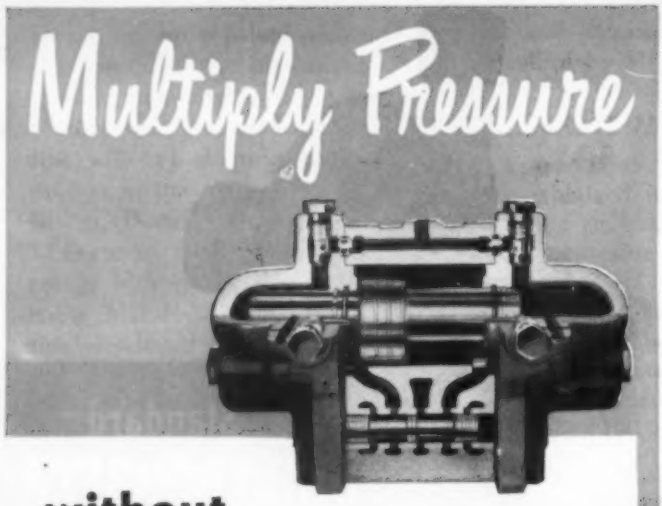
Pump No.	Speed	H.P.	Inlet	Outlet	Gallons Per Minute—Head in Feet							
					0	4	6	8	12	16	20	24
1G	1725	1/12	⅛	⅛	2.00	1.05	0.10	—	—	—	—	—
1G	3450	1/12	⅛	⅛	4.00	3.70	3.50	3.25	2.75	2.10	1.25	0.10
4G	1725	¼	⅜	½	10.75	7.50	4.00	—	—	—	—	—
4G	3450	¼	⅜	½	23.00	22.00	21.58	21.00	18.75	15.25	11.50	8.00
9G	1725	⅛	1¼	1	35.00	32.66	31.66	29.50	26.00	21.66	15.00	3.50

PRICE LIST

No. 1G $9.25	No. 4G $16.00	No. 9G $24.00

Industrial Pump Div., Oberdorfer Foundries, Inc.
526 Thompson Rd., Syracuse, N. Y.

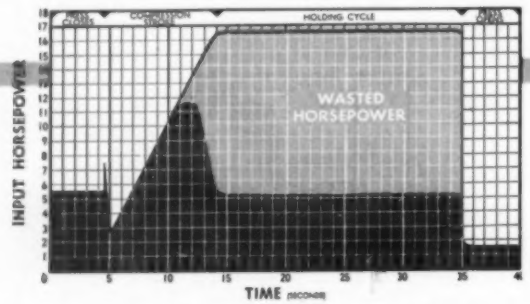
Circle 55 on Reader Service Card



without increasing horsepower

On most presses and in many other applications, pressure requirements change during the operating cycle. The Racine "Variable Volume" low pressure pump with a Racine Pressure Booster can be used to develop and hold up to 5000 psi. The horsepower input does not exceed the power needed to operate the pump at its low pressure setting.

This means lower first cost, less horsepower consumption, reduced cylinder sizes—a more compact over-all design. Pressure and volume delivered can be controlled by one of the built-in governors that are standard for all RACINE pumps.



OPERATING ECONOMIES—The colored area in the graph above shows the horsepower lost during one holding cycle of a simple press circuit using a constant volume pump. The black area shows the horsepower consumed when a Racine "Variable Volume" Pump and Pressure Booster is used to do the same work.

BUY DEFENSE BONDS

OTHER RACINE HYDRAULIC PRODUCTS

RACINE

HYDRAULICS & MACHINERY, Inc.

2074 Albert St., RACINE, WISCONSIN, U.S.A.

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jack or preloader. This squeezes the two beam assemblies against the part being tested with a force up to 250,000 pounds pressure. The weight is started rotating, setting up a violent vibration. This force is equal to the force of the hydraulic jack. The total force is alternated rapidly in opposite directions, compressing and stretching. Strain gauges on the test part keep a record of the exact force applied.

The new machine can cycle its total force as fast as 2000 times per minute or as slow as 5 times per minute, the widest range of any fatigue testing machine. In addition to the new giant, Lockheed has one 50,000 pound and six 10,000 pound fatigue machines, all designed and built at Lockheed.

How To Cut Hydraulic Tubing

Continued from page 44

Burring

All tubing which is cut has a burr. The burr may be either internal or external, or both. If the tubing is cut by a hacksaw, it must be smoothed with a file before the burr is removed. A hacksaw produces scratches on the end of the tubing. These scratches should be removed to prevent the tube from splitting when it is flared. The tubing must not be distorted by holding it in a vise. Soft or thin walled tubing is very easy to distort.

It is not necessary in every case to remove the internal burr on tubing. However, for the beginner, the safe rule is to remove the burr. All external burrs must be removed to assemble the sleeve, nut or other holding device over the end of the tubing.

A special machine may be used for burring. Flaring machines usually provide accessories for cutting and burring. However, for most applications, the external burrs can be removed by a smooth file. In removing the burr, care should be taken not to nick the end of the tubing. This applies particularly to flared tube fitting applications, but is equally true of many of the flareless types of fittings usages.

If a heavy internal burr is thrown up in the end of the tubing as a result of the cut-off or other handling, it should be removed. A triangular scraper is the best hand tool to do this, although a knife, the tang of a file, or any number of other devices may be used. When such a burr is removed, there should be no nicks which were produced as a result of the burring device. If nicks in the edge are produced, a longitudinal split may develop.

In no case should a sharp edge at the end of the tubing be produced by the burring operation. In other words, do not permit the burring to thin the walls of the tube. If this is done, a bad flare will be produced. With flareless fittings, a thin edge may dig into the seat or wedge into the counterbore and result in a damaged tube or fitting seat.

Part II of this series will discuss flaring, bending and installation of tubing.

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The Higher the Pressure ...the Tighter the Valve

On hydraulic presses of all types this Yarway Hydraulic Valve will give long life with minimum maintenance. Automatically regrinds its own sealing surfaces. Small and compact. Easy to install and operate.

Yarway Single-Pressure Hydraulic Valves are made in straightway, three-way and four-way types; in five sizes for pressures up to 5000 lbs. Also Yarway Two-Pressure Valves in two sizes for pressures up to 5000 lbs. Write for Bulletin H-210.

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155 Mermaid Ave., Philadelphia 18, Pa.

YARWAY
Improved Type
HYDRAULIC VALVE

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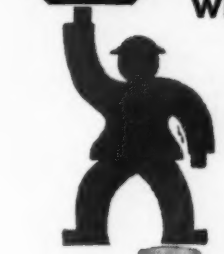
STOP DOWN TIME ON AIR-OPERATED EQUIPMENT With the HANNIFIN "AIR WARDEN"



High production schedules *DEMAND* continuous performance from air-operated equipment. So Hannifin developed the "Air Warden" as the finest protection possible.

One complete "Air Warden" unit FILTERS AIR — REGULATES PRESSURE — LUBRICATES —*Simultaneously!*

GET ALL THE DETAILS ON HANNIFIN'S MONEY-SAVING "AIR WARDEN"!
Components sold singly or in any combination. Write for literature.

HANNIFIN

Hannifin Corporation, 1155 S. Kilbourn Ave., Chicago 24, Illinois

Depend on DARCOID O-RINGS

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Take advantage of Darcoid's complete O-Ring service facilities—immediate delivery from complete stocks!

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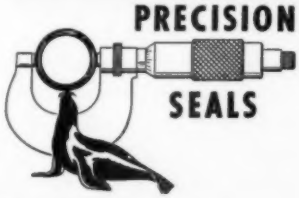

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DANBURY, CONNECTICUT
REPRESENTATIVES IN PRINCIPAL CITIES

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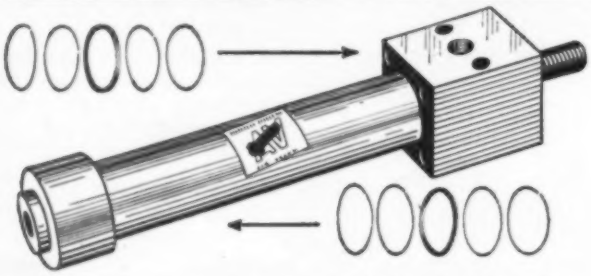
LOWERS MANUFACTURING COSTS
PROVIDES BETTER CYLINDER EFFICIENCY



Heavy duty Airmatic cylinders, made by Airmatic Valves, Inc., Cleveland, and widely used in the aircraft and other industries, now use PALMETTO G-T Rings in place of conventional type packings.

By employing G-T Rings—which require only a rod and piston groove—Airmatic has been able to simplify cylinder design; eliminate complicated stuffing boxes, back-up plates and hold-in bolts. As a result, manufacturing costs have been drastically reduced.

And, because G-T Rings—unlike conventional Rings—cannot roll in the groove under high pressure, spiralling and extrusion of packing is no problem . . . smooth, efficient performance is assured with minimum servicing of packing. Heavy duty Airmatics, with 1" bore cylinders, operate at pressures up to 1500 psi on oil or water—exert a force on the ram equal to 78% of the input. More than 5,000,000 trouble-free 3" strokes have been recorded on original Airmatic cylinders with PALMETTO G-T Rings.

HOW PALMETTO G-T RINGS WORK . . .

NO PRESSURE

NON-EXTRUSION RINGS

CLEARANCE FLANGE

CYLINDER WALL RESILIENT SECTION

Fig. 1 shows Palmetto G-T Rings with no pressure applied. CLEARANCES between the FLANGES of the RESILIENT SECTION and the laminated plastic NON-EXTRUSION RINGS, as well as between rings and CYLINDER WALL prevent low pressure friction.

UNDER PRESSURE

Fig. 2 indicates how the RESILIENT SECTION flows under pressure, causing the FLANGE to swell under the rings on the low pressure side, bringing them to bear on the CYLINDER WALL. CLEARANCE spaces are closed, preventing any extrusion of the packing material. The piston, forced to a central position, will move forward without binding or jamming and with no damage to packing or CYLINDER WALL. Elimination of extrusion of the packing material is the outstanding feature that makes Palmetto G-T Ring Packing the ultimate in seals.

If a better packing will better the product you make, count on Greene, Tweed to lend assistance. Write for literature that describes all PALMETTO Packings.

PALMETTO Packings

packing more performance into every application

GREENE, TWEED & CO. NORTH WALES, PA.

Circle 31 on Reader Service Card

Piping Pointers for Hydraulic Circuits

Continued from page 39

Stacking of Tubing: Stacking or placing tube lines closely together is permissible only when the progression can be accomplished immediately following right angle bends and a general change in direction, normally with the terminals of the tubing within machine cavities.

Fish or fan tail arrangement of tubing is unsightly and it is difficult even for an experienced craftsman to produce an orderly arrangement of similar and progressive bends. Such arrangements may be required where several lines of tubing must converge in entering a limited space or cavity.

It is recommended that, whenever possible, the fan tail be symmetrical, Figure 3, beginning with the center tube and working outward and that the convergence contain and occur with a general change of direction, preferably a right angle.

When several lines of tubing are close together, any individual line or lines should be removable without disturbing the remainder of the series.

Manifolding: Both control panel and machine should have a manifold. Manifolding makes a break away for movement or shipment easier and safer; protruding tube ends that invite damage, are avoided.

Hole spacings or fitting positions in manifolds should be laid out to allow insertion of fittings on the basis of the required clearances. Tee connections usually will require the greatest clearances. When it can be accomplished without crossing lines, it is preferable to combine lines of tubing at a manifold, rather than use a tee fitting.

Additional manifolds and bends do add to the number of fittings. However, repeated checks with manifold systems indicate that the pressure drop rarely exceeds 2 percent. In view of the efficiency factor designed into machine tools and production equipment, a 2 percent pressure drop can be absorbed with little or no effect.

Clearance Space: A clearance space between a machine member and a line or number of lines of tubing should always be provided. A clearance space allows chips, dirt or other contaminants to fall free of the tubing and permits easier cleaning of tubing and adjacent machine areas, promoting good shop housekeeping. With clearance provided, tubing should be suported at intervals. Such intervals depend on the size of the tube and other factors, as noted previously; average intervals will run from 4 to 6 feet.

When tubing lines closely follow the contour of a machine member, Figure 2, the lines are less subject to damage with a clearance space. A sudden blow or external shock may dent or spring

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HYDRAULIC EQUIPMENT
WITH HIGH PRESSURE
MICRONIC FILTERS

• 3000 p.s.i. Operating Pressure, Micronic Filtration, Low Pressure differential, Compact in Line Type.

• Maximum Protection at minimum cost. Replaceable element.

• Built-in Relief Valve prevents crushing of element due to dirt accumulation.

WATERMAN ENGINEERING Company

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ENGINEERED HYDRAULIC DELUXE
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We modernize your present equipment in use now; let us propose our manifolded valve mounting panels to cut downtime, by eliminating cause.

Our units were designed to meet or to surpass all "J.I.C." standardizations and not copied from other existing similar power units.

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☆ LIGHT WEIGHT
☆ QUICK CONNECTING
☆ POSITIVE LOCKING
☆ HIGH PRESSURE SEAL
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☆ WIDE TEMPERATURE RANGE
☆ SIZES FROM ¼ INCH TO 6 INCH

* FOR MANY VARIED INDUSTRIAL USES:
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- Liquid transfer and closed hydraulic systems

OPEN COUPLINGS

SELF-SEALING COUPLINGS

CAPS & PLUGS

Features like these mean CONNECT WITH ROYLYN!

★ **SIZE RANGE** . . . ¼ inch to 2½ inches. Up to 6 inches in some styles.

★ **PRESSURE RANGE** . . . 6600 to 650 P.S.I.

★ **MATERIALS** . . . Aluminum alloy, brass, carbon steel, alloy steel and stainless steel.

★ **OPERATION** . . . A simple "twist of the wrist"—NO TOOLS REQUIRED!

★ **POSITIVE LOCK** . . . Locks with a "snap" and positively will not uncouple with vibration, pressure or rotation of the connected hose.

★ **SAFETY** . . . Laboratory tests for extremes of heat, cold, vibration and years of hard service have proven its rugged reliability.

★ **VERSATILITY** . . . Open nipple can be used with self-sealing coupling to provide shut-off on one side only. Also open coupling can be used with self-sealing nipple to provide check valve action.

There is a Roylyn Coupling available for practically any type of flexible connection for air, water, hydraulic and chemical applications. Write today for free illustrated catalog and nearest dealer. Inquiries regarding available dealerships are invited.

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The ARDEE valve controls AIR, WATER, OIL, VACUUM and various GASES up to 150 lb. psi for gases and 200 lb. psi for liquids.

There is an ARDEE valve for every job. Depending on the service requirements, valve bodies can be furnished in brass or aluminum. The sealing members are molded of various resilient materials suitable for those requirements.

JUST A FEW APPLICATIONS: . . . *Road machinery, plastic machinery, tire retreading machinery, special installations, material handling equipment, vacuum spray booths, vacuum material handling, punch press operations, hydraulic press, platen presses for rubber industry.*

SIMPLE EXTERNAL ADJUSTMENT KEEPS ARDEE VALVE LEAK PROOF • The ARDEE valve employs the N.I.F. principle • Closed center on all ports • Metering principle • Easy mounting features • Low handling load • Ports and passages unobstructed.

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FALL WIPER RINGS

Keeps the Piston Rod CLEAN in Extreme Temperatures —High or Low

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3 Piece Type Spec. AN6231A. Spec. MIL-S-5049

We make sizes AN6231A1-½" to AN6231A71-13"

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2 Piece Type Industrial

Covered by Patents Issued and Patents Pending.

SPRING LOADED with "SQUEEZE-GRIP" ACTION

The piston rods of landing gear, bomb lifts and other hydraulics can be kept absolutely clean and free from all foreign bodies including ice in extreme temperatures high or low with Fall Wiper Rings.

USED DURING WORLD WAR 2

Accepted during world war two and used ever since by the Military is proof the Fall Wiper Ring is correct in design, that it has high quality workmanship strictly adhering to MIL-S-5049 with rigidly controlled inspection.

Made in all sizes for piston rods from ½" to 13" diameter. (Military part numbers range from AN6231A1, ½" diameter to AN6231A71, 13" diameter).

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SET A NEW HIGH in Slow Wearing

Featuring specially treated hard seats and lapping flat discs that become tighter with use, Nicholson cylinder control valves are setting records for long wear and leak-free service. Choice of 6 metal combinations to meet specific needs. Types for air, gas, steam, water, oil and other liquids.

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Lever models (left), ¼" to 2½", pressures to 5000 lbs. Foot models (above), ¼" to 1½", pressures to 300 lbs.

Motor (left) and solenoid types, ⅛" to 2½"; pressures to 375 lbs.

CATALOG 552

213 Oregon St., Wilkes-Barre, Pa.

W. H. NICHOLSON & CO.

TRAPS · VALVES · FLOATS

Circle 53 on Reader Service Card

the lines, rather than flatten them, as might happen if lines were flush against the machine member.

Air Bleeders: Air bleeders should be provided in the highest point in each section of the tubing circuit where critical movements are controlled.

Beginner's Course in Basic Pneumatics

Continued from page 54

The formula can be transposed to solve for any factor:

$$p = \frac{53.3\ MT}{V};\quad V = \frac{53.3\ MT}{p};\quad T = \frac{pV}{53.3M};\quad M = \frac{pV}{53.3T}$$

Since by definition R is the work done by one pound of air when its temperature is increased 1 degree F at constant pressure, the value of R is the specific heat at constant pressure. For convenience in calculations R is often expressed in its heat equivalent as

$$\frac{53.3}{778.2\ *} = .0686 \text{ Btu per pound}$$

*778.2 Btu = one ft-lb

Specific Heat

The specific heat on any substance is the number of Btu needed to raise the temperature of one pound of the substance one degree F. In air work we are concerned with two values of specific heat: (1) specific heat at constant pressure and (2) specific heat at constant volume.

Specific heat at constant pressure (C_p) and specific heat at constant volume (C_v) are the two components of specific heat. Specific heat at constant pressure (C_p) is the heat expended in doing the "external" work, i.e., the energy used in changing the density of the air; specific heat at constant volume (C_v) is the heat expended in doing the "internal" work, i.e., the heat required to raise the temperature of the air only.

The total specific heat or simply specific heat of air, as determined by Regnault, is .2375 Btu per pound. Since the heat equivalent of R is .0686 Btu per pound, the difference (.2375 −.0686 = .1689 Btu per pound) is the specific heat of air at constant volume.

The ratio of the specific heat at constant pressure to the specific heat at constant volume, written $\frac{C_p}{C_v}$ or n, is an important one in compression. In the two types of compression, the value of n is 1 for isothermal change (temperature kept constant with the heat of compression removed); in adiabatic compression (heat of compression retained) the value of n becomes the ratio of specific heat at constant pressure to the specific heat at constant volume. For dry air this is:

$$\frac{.2375}{.1689} = 1.41$$

The next installment will introduce Adiabatic and Isothermal Compression.

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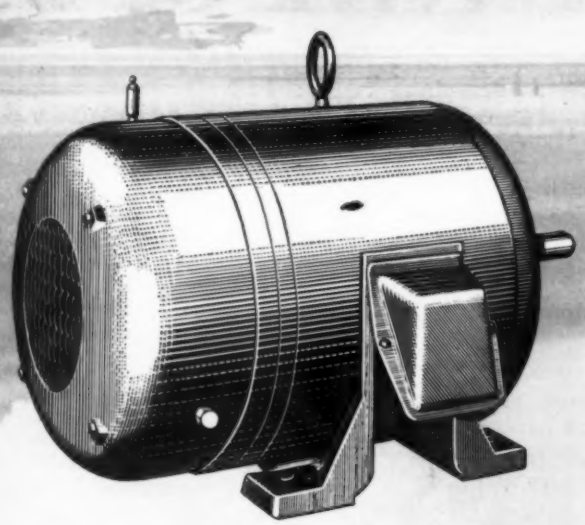
INDUSTRIAL MOTORS

Built to OUTLAST



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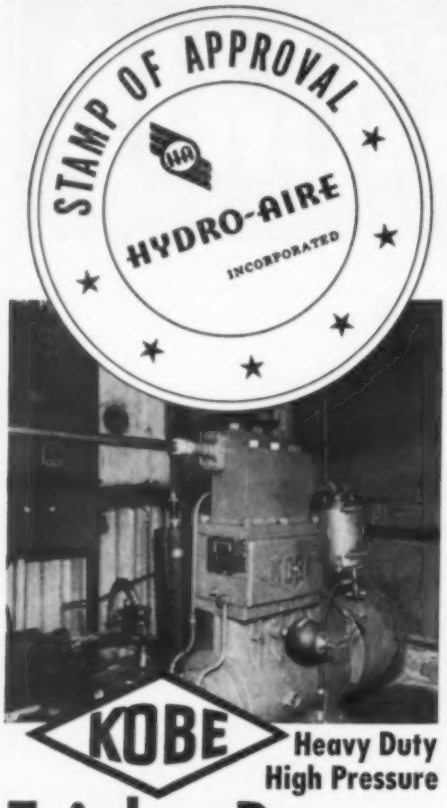

KOBE Heavy Duty High Pressure

Triplex Pumps

Case History A7: Hydro-Aire, Inc., Burbank, California, manufactures aircraft fuel system elements and hydraulic and electrical equipment. In April, 1948, they installed a Size 3 Kobe Triplex to test hydraulic accessories.

Easy Interchangeability Required

The service called for intermittent operation at 3000 to 5000 p.s.i. Requirement for such a wide range of pressures was easily met by the Kobe Triplex because of its feature of quick and simple interchange of plungers and liners.

To Be Used Also in New Texas Plant

Hydro-Aire's full satisfaction with the Kobe Triplex is best indicated by the fact the Company plans a similar installation in its new Texas plant, scheduled for Fall opening.

Triplex Features

- Pressures — To 5,000 psi (standard) To 20,000 psi (special)
- Volumes — To 60 g.p.m.
- Power Ratings — 15, 30, and 50 H.P.
- Integral Double Reduction Gears
- Integral Electric Drive (Optional)
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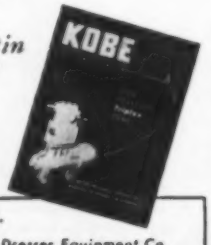

KOBE INC.
Division of Dresser Equipment Co.
Plant: Huntington Park, Calif. — Representatives in CLEVELAND, Pittsburgh, New York, Houston, Oklahoma City.

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POST SCRIPTS OF INDUSTRY

NEWS · VIEWS · TRENDS

George S. Cherniak has recently been appointed vice president of engineering for **Control Engineering Corporation** of Canton, Massachusetts. Mr. Cherniak was previously associated with Anderson-Nichols, Consulting engineers of Boston. He will be responsible for the engineering operations of the Corporation including the development of new products and applications of existing products and facilities to new problems.

G. S. Cherniak

Ward Leonard Electric Co., Mount Vernon, N.Y., announces that their Los Angeles branch office and warehouse have been moved to new, larger quarters located at 1605 E. Olympic Blvd., Los Angeles 21, Calif.

The Fulton Sylphon Division of the Robertshaw-Fulton Controls Company, Knoxville, Tennessee has acquired all manufacturing, sales and patent rights in the seal developments of Renniks Company and Ralph L. Skinner, Sr. of Detroit. All operations have been moved to the Knoxville plant. Ralph L. Skinner, Sr. will continue to participate in the seal program as a consultant on design and application problems. His son Ralph L. Skinner, Jr., has joined the sales department of Fulton Sylphon Division in the capacity of sales engineer.

George T. Keller has been appointed manager, customer service department at **Pacific Airmotive Corporation,** Burbank, California. Mr. Keller has previously been associated with Pratt & Whitney Aircraft Division, Air Carrier Engine Service and most recently with Southwest Airmotive Corporation.

George Tate has recently joined the Aircraft Sales Division of Vickers Incorporated as application sales engineer in Canada and the Northeastern United States. He will be based at Detroit. Mr. Tate has a long history in the electro-hydraulic field. Most recently he spent a year in the engineering laboratory and with the engineering liaison group at Vickers. Formerly affiliated with the Sperry Gyroscope Company, Mr. Tate handled the first general airline auto pilot installations at TWA in 1935.

George Tate

Equipment Sales Corporation, 341 W. Market Street, Kingsport, Tennessee has been appointed representative for the **Conoflow Corporation.** Headed by S. E. Abernathy and R. Glynn Thomas, Equipment Sales serve eastern and central Tennessee as well as southwestern Virginia.

William H. Steinkamp has been appointed sales manager of the industrial division of **Minneapolis-Honeywell Regulator Company.** Mr. Steinkamp has been industrial field sales manager since 1943. He succeeds L. Morton Morley, who continue as vice president of Brown Instruments division.

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Pathon

HYDRAULIC CYLINDERS

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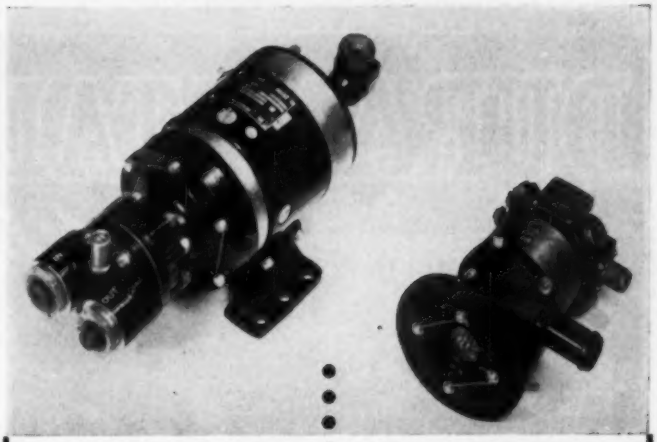

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Type 389; Model 2 & 3
Mfg. by ECLIPSE-PIONEER
Guaranteed brand new.
Original packing
Capacity 3½ g.p.m.;
600 p.s.i.; 24 v dc motor.

FUEL BOOSTER PUMP Type TFD 8200

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THOMPSON PRODUCTS, INC.
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Capacity 180 g.p.h.;
8 p.s.i.; 24 v dc. 5.2 Amps.

Pump also available as separate unit

A large quantity on hand.
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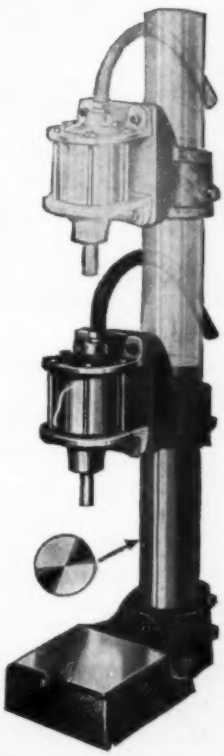

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MANUFACTURERS OF METALLIC and SEMI-METALLIC PACKINGS
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Broaching Pioneer Observes 50th Anniversary

The Lapointe Machine Tool Co. of Hudson, Mass., pioneers in broaching as a factor in industrial production, celebrates their Golden Anniversary this year. Incorporated in 1902 in Boston, the company has remained a leader in the design and manufacture of broaches and broaching machines; the present group of plants at Hudson constituting the largest manufacturing unit in its field.

The principle of broaching has been closely related to the growth of Lapointe during its 50 years. The development of engineering principles and the promotion of the use of broaching methods, machines, fixtures and tools has kept pace with the demand for the mass production of precision parts.

The company introduced the first screw-type broaching machine in 1902; the first broach sharpener and the first hydraulic broaching machine made their appearance in 1923; the Lapointe "Roto-Kut" for handling primary operations, par-

MAINTENANCE MEN!

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Fewer Valves to Stock. Same valve operates either 2-way or 3-way, normally open or normally closed. 4-way valves also available. Pilot valves for remote control.

Fewer Parts to Stock. Every moving part of main or "master" valve fits in an easily removable cartridge. NO SPRINGS! Two sizes of cartridge fit all 5 valve sizes. Pilot heads (solenoid or pressure operated) fit any size valve.

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All Sizes From ¼" to 1¼" I.P.S.
Pressures From 15 to 150 P.S.I.
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FINEST QUALITY and PERFORMANCE at MINIMUM COST!

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★ Single Action
★ Double Action
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Whether your primary problem is performance, delivery or price it will pay you to contact BRUNING today.

Complete specifications, and prices will be forwarded upon request.

NOTE—Bruning cylinders comply with the latest A.S.A.E.—S.A.E. standards for farm implements.

the Bruning Company LINCOLN NEBRASKA

DESIGNERS AND MANUFACTURERS OF PRECISION HYDRAULIC EQUIPMENT

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ticularly on malleables and forgings was introduced in 1925; and the first automatic indexing and turret machine for handling multiple operations and cuts appeared in 1941.

Lapointe was a pioneer in the use of hydraulic power for broaching machines. The first hydraulic machines, mentioned above, was delivered to the Buick Motor Car Co. on July 26, 1923. A horizontal type, the machine was used for internal work with an 8 inch cast iron cylinder mounted on the rear end of the machine bed. The circuit included a variable delivery, multiplunger pump for a recommended maximum operating pressure of 1000 psi. With a draw rod stroke of 64 inches, the speed was controllable from 0 to 24 fpm on the working stroke with a constant speed return of 60 fpm. A spring and plunger type stop automatically controlled the length of the work stroke.

Some outstanding broaching records were made by Lapointe equipment during World War II. Broach rifling of gun barrels was stepped up ten times with practical elimination of previously heavy rejects.

A pioneer user of hydraulics to operate both horizontal and vertical broaching machines, Lapointe was also one of the first to use lower operating pressures on large production broaches. More recently, they have pioneered the extensive use of hose for hydraulic systems.

More Power for the Family Farm

An all purpose, hydraulically operated blade for use with small standard tractors, a recent development of the Danuser Machine Co., Fulton, Mo., provides an earth moving implement of unusual versatility. The six foot moldboard blade can be raised, lowered or turned to any angle for a wide range of bulldozing, terracing, ditching, grading, backfilling, scraping, snow removal and many other farm jobs.

The unit is furnished in kit form for hydraulically equipped tractors. It is flexible enough to mount on a number of nationally known family size tractors. The illustration shows the Danuser all-purpose blade mounted on a Case VA series tractor, with the blade up. The unit is easily controlled by one lever from the tractor seat.

The compact implement is three point, tandem mounted; the cast steel tubular frame is raised and lowered by a double acting cylinder. The blade is mounted on heavy roller bearings; the swivel action, tiller type bar permits quick changes and positive locking of the blade in a number of positions.

"SEAL-GUARD"
METALLIC ROD WIPER

PROTECTS YOUR CYLINDER RODS, MACHINE SPINDLES, GUIDE PINS AND LOCATING PINS

The "Seal-Guard" Metallic Rod Wiper affords permanent protection from falling or flying debris . . . Two flexible bronze rings mounted in synthetic rubber lift off harmful substances completely by means of their knife-edged conical surfaces . . . The device is self-adjusting through action of rubber on staggered scraper rings . . . Rod diameter sizes are from ½ to 10 inches.

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Denison
Model HTS-3EM

- Delivers 3000 psi. at 3.26 GPM
- Powered by 7½ HP. 3/60/220 motor
- Complete with Accumulator, Filters, Circuit Controls, hoses and instruments—READY TO OPERATE

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Hydraulic and Pneumatic Committee Resumes Monthly Meetings

The Committee on Hydraulic and Pneumatic Systems, sponsored by the Southern California Section, ASME, will again hold general meetings beginning in May. At the May meeting on May 21st, held at the University of Southern California Engineering auditorium in Los Angeles, J. L. Dooley, director of research, Rhodes Lewis Co. was speaker. Howard Field, Jr., Consolidated Vultee Aircraft Corporation, and formerly chairman of the Committee, is scheduled to speak at the June meeting.

The Committee on Hydraulic and Pneumatic Systems, organized in December 1948 by Anthony Hunter and Dr. Peter Kyropoulos, then directors of the Hydraulics Division of the ASME Southern California Section, held meetings for over two years; the meetings were discontinued because of the pressure of work on many of the most active members. Some of the activities of this Committee, including work on a Good Practices Manual, are anticipated, at least on a limited scale.

J. S. Newton, research engineer, North American Aviation, Inc., is the present chairman.

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NEW SKINNER SOLENOID VALVE

EXPLOSION PROOF TYPE X5

THE new Skinner X5 Solenoid Valve is basically the same as the widely accepted and tested V5, but modified to a construction that is Underwriters' approved for Class I, Group D hazardous locations. Small size and lightweight features are retained, and the X5 is low in price because of the many parts which are interchangeable with other Skinner valves. Rating is 10 watts max.; soft, spring loaded seals prevent leakage; internal parts are stainless steel; wide variety of port locations in 1/8" and 1/4" size; most types available for metering; for AC or DC in a wide range of voltages and frequencies; can be mounted in any position; supplied as two-way normally open or closed, three-way normally open, closed or directional flow. *Write today for details!*

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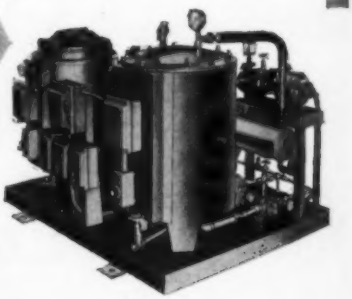
Restores used hydraulic oil to like-new condition

HOFFMAN OIL CONDITIONER



Removes soluble and insoluble impurities

Capacities from 25 to 600 g.p.h.

Protects your hydraulic equipment—lengthens oil life without high maintenance cost of centrifuges. The Hoffman Oil Conditioner consists of a cartridge filter and vaporizer, mounted on a common base, portable if desired. Complete with all necessary electric and pump connections. Only two moving parts—no steam or water connections. Write for technical bulletins.

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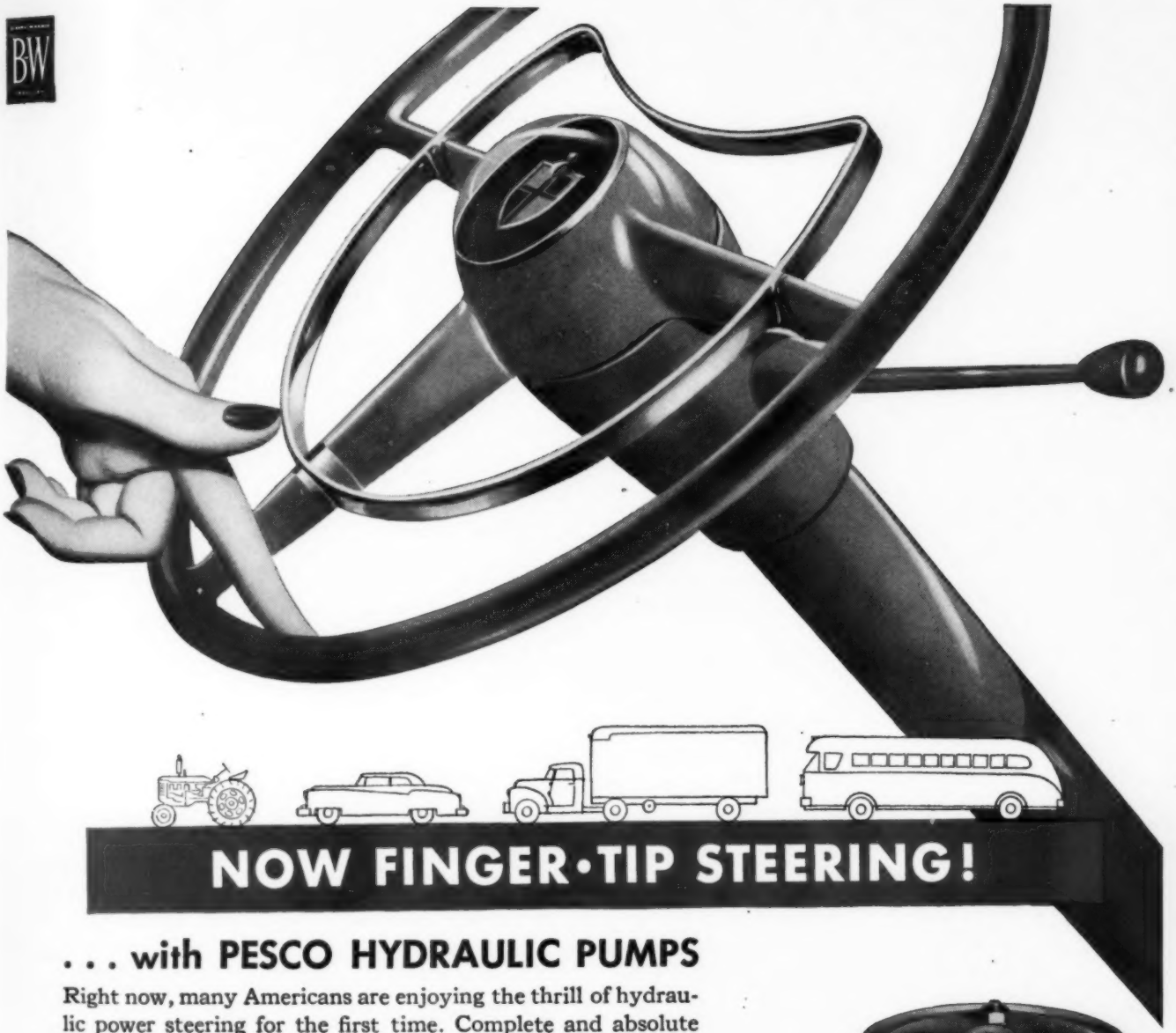

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. . . with PESCO HYDRAULIC PUMPS

Right now, many Americans are enjoying the thrill of hydraulic power steering for the first time. Complete and absolute control of the vehicle is obtained at all times . . . perfect safety, even on soft shoulders or in case of a blowout. Now, just the touch of a finger to the wheel, at any speed, and the vehicle responds surely and easily.

Less driver fatigue and increased pay loads for truckers are just two of the many benefits of hydraulic power steering.

Pesco engineers have worked hand in hand with automotive engineers in the development of a pump for this unit, which is one more in a long series of important developments in the field of *pressurized power and controlled flow*.

Investigate the advantages of hydraulic power steering for the vehicles you manufacture. Perhaps Pesco's experience can be helpful to you. Why not call us?

New Pesco Hydraulic Power Steering unit for passenger cars consists of pump and reservoir.

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PRODUCTS DIVISION

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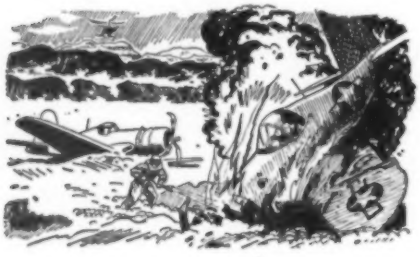
IT WAS A BRIGHT EARLY DECEMBER DAY and Lieutenant Hudner was flying a Korean combat mission alongside another plane piloted by Ensign Jesse Brown. A burst of flak



caught the ensign's plane and he went spinning down, aflame. Lieutenant Hudner then deliberately crash landed near his flame-trapped shipmate. He radioed for help, after which he fought to keep the fire away from the fatally injured ensign until a rescue helicopter arrived. Today Lieutenant Hudner says:

"Maybe if America had been strong enough to discourage aggression two years ago, my friend, Jesse Brown, might be alive right now. So might thousands more of our Korea dead.

"For it's only too sadly true—today, in our world, weakness invites attack. And *peace is only for the strong.*

"Our present armed forces *are* strong—and growing stronger. But don't turn back the clock! Do your part toward *keeping* America's guard up by buying more . . . and more . . . and more United States Defense Bonds *now!* Back us up. And *together* we'll build the strong peace that all Americans desire!"

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Remember that when you're buying bonds for defense, you're also building a personal reserve of savings. Remember, too, that if you don't save *regularly*, you generally don't save at all. So sign up today in the Payroll Savings Plan or the Bond-A-Month Plan. Buy United States Defense Bonds now!

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Buy U. S. Defense Bonds now!

Lt. (jg) Thomas Hudner, Jr. U. S. N.

Medal of Honor

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